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REPORT ON FUNCTIONAL DESIGN SPECIFICATION FOR THE
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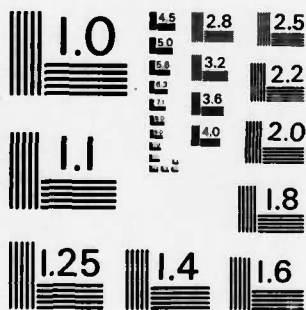
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AD-A142518

Report on Functional Design Specification
For The
Automated Alphanumeric Data Entry System
Contract #N00014-83-C-0749
Data Item: A002
30 January 1984

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Report on Functional Design Specification
For The
Automated Alphanumeric Data Entry System
Contract #N00014-83-C-0749
Data Item: A002

Submitted By:
PAR Technology Corporation
Geographic Systems Section
7926 Jones Branch Drive, Suite 170
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30 January 1984

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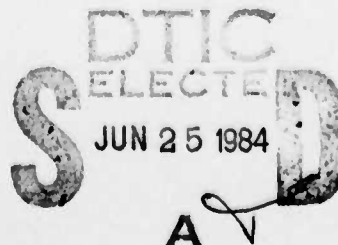


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1.0 AADES OVERVIEW

The Automated Alphanumeric Data Entry System (AADES) will provide DMA with an integrated system for bulk input of geoname data from maps and hardcopy gazetteers. Maps used as input data sources will include DMA map series and non-DMA maps (foreign and domestic). The geoname information that is captured will be used to generate a geonames file that will be input to the Geographic Names Data Base (GNDB). This file will include information on the geoname itself (specific and generic components, if applicable), the position of the feature to which the name refers, the feature's designator or class, the source document, the country (or countries) the named feature is in, the feature's attributes, and the non-Romanized name (if applicable).

AADES will provide DMA with the capability to build the Geographic Names Data Base cost effectively from the richest existing source of geonames and related information, maps. Existing technology and off-the-shelf system components will be used as much as possible. As discussed in this report, an interactive approach to AADES can be implemented using currently available hardware and software. Considerable time and cost savings may be achieved by automating certain of the AADES functions. Some of these automation objectives require software development in order to be achieved.

This report describes existing methods and systems that relate to the AADES objectives and points out their respective deficiencies and strengths. Current or previous operational geonames-capture programs or systems are reviewed, with emphasis on the technical approaches they used and on their strengths and weaknesses (Section 1). The state of the art in specific hardware and software technology areas, such as automatic character and word recognition, scanners,

and scanning "wands," is defined to permit comparisons of a variety of alternative technical approaches and scenarios.

A major objective of this report is to examine the functions that must be carried out in the AADES to produce the required geonames file from the input source material. In specifying these functions (Section 2), we have attempted to remain as technology-independent as possible. The basic functions analyzed must be performed without regard to any particular technical approach to AADES (that is, manual, interactive, or automated).

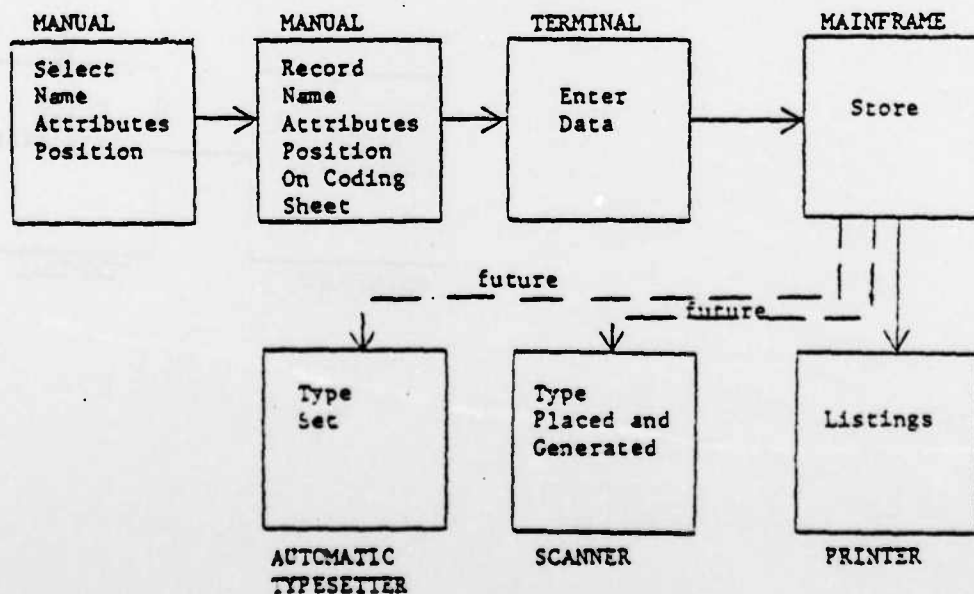
In the remainder of the report, specific hardware and software requirements are analyzed. ^{→ Another →} Our objective is to present information that may be useful for comparing alternative hardware and software configurations or scenarios by identifying what the current state of the art can support and what capabilities must be developed. The concluding section of the report describes a preliminary trade-off analysis for the major technologic alternatives and presents recommendations for subsequent AADES trade-off analyses and system specification.

1.1 Existing Systems

The seven examples chosen for description are representative of geographic names entry systems that support digital data bases. They range from seasoned to prototype systems. The USGS example is significant because of its documented costs. Two prototypes, the Scitex and the Intergraph, are combined because of similar approaches and lack of additional information.

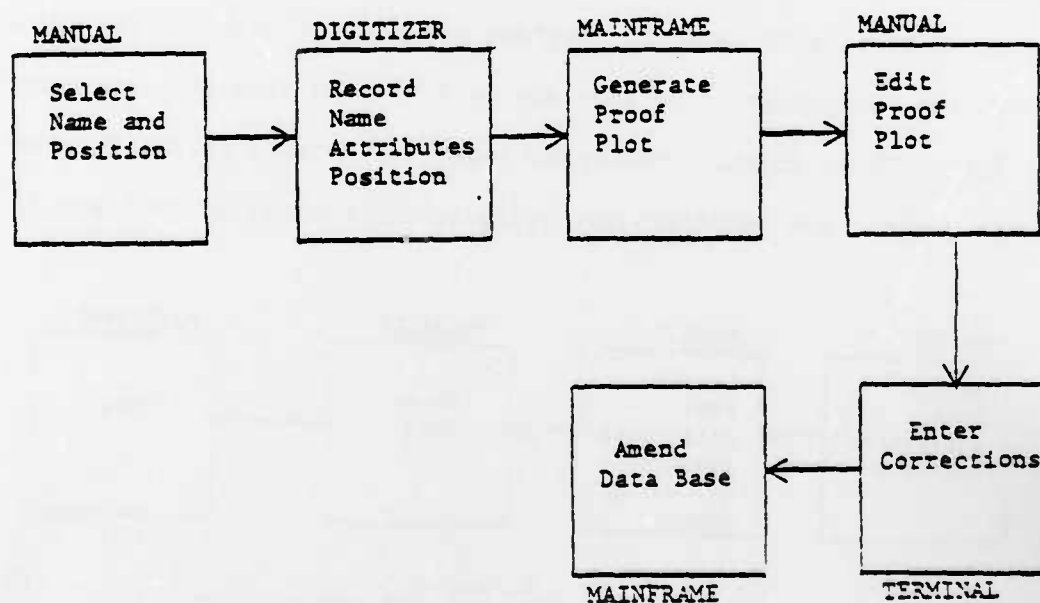
1.1.1 Manual - National Geographic Society

The initial purpose of the Geographic Names Data Base (GNDB) system is to provide correctly spelled names for user-specified location and other parameters. Later versions will do typesetting and placement. To enter names in the system, the researcher first fills out one or more of five different coding sheets. Coordinates are in degrees and minutes only and are manually calculated by the researcher. The data are next entered from the coding sheets through an IBM 3278 terminal. Unaccented names are entered first, followed by accented names which are entered by using special-character overlays on the keyboard.



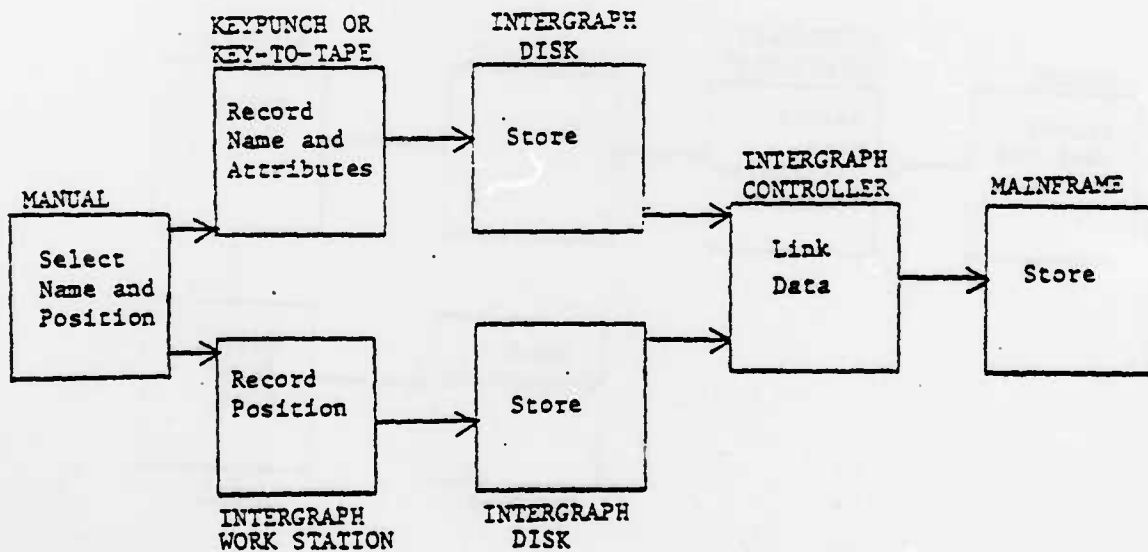
1.1.2 Manual Plus - U.S. Geological Survey

The Geographic Names Branch of the USGS has captured all of the names appearing on its maps, other than roads and highways, for the purpose of maintaining an authoritative on-line file of geographic place names. Future enhancements include capture of names from all sources, then road and highway names, together with an interface to an automated names selection-generation-placement system. The input steps are selection of the name, marking of the point (or points) referenced, digitizing the point, entry through a digitizer keyboard of the name and attributes (such as feature, area codes, and map number), and then verification. This was accomplished by a small business minority contractor and was considered very successful.



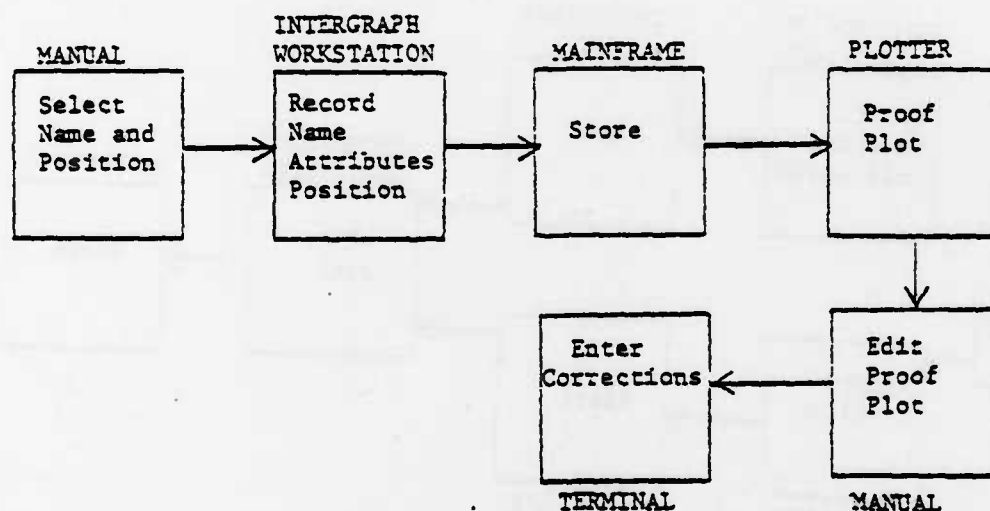
1.1.3 Interactive - Chicago Aerial Survey

Following the selection of the names, the names and associated information are either keypunched or keyed to tape. The cards or tape are then entered onto disk utilizing the Intergraph Data Management and Retrieval System (DMRS). The Intergraph workstation is then used to read the position on the map and to link the coordinates with the previously recorded name information.



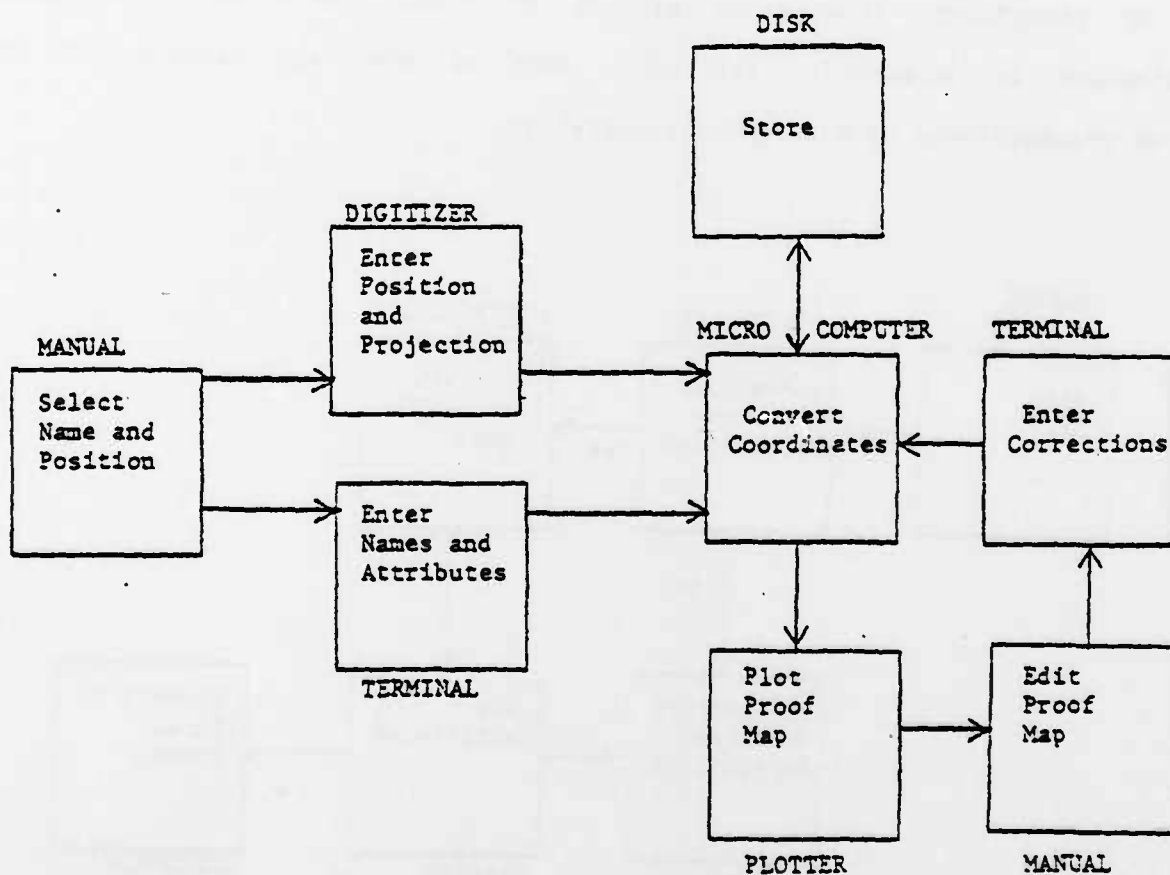
1.1.4 Interactive Plus - Central Intelligence Agency

Following selection, the names, position, and associated information are entered at an Intergraph workstation using the Interactive Cartographic Analysis Design and Drafting System (ICADDS) program. The data are then transferred to the mainframe, plotted, and listed. Following edit, the corrections are performed on the Intergraph and the plotting and listing are repeated.



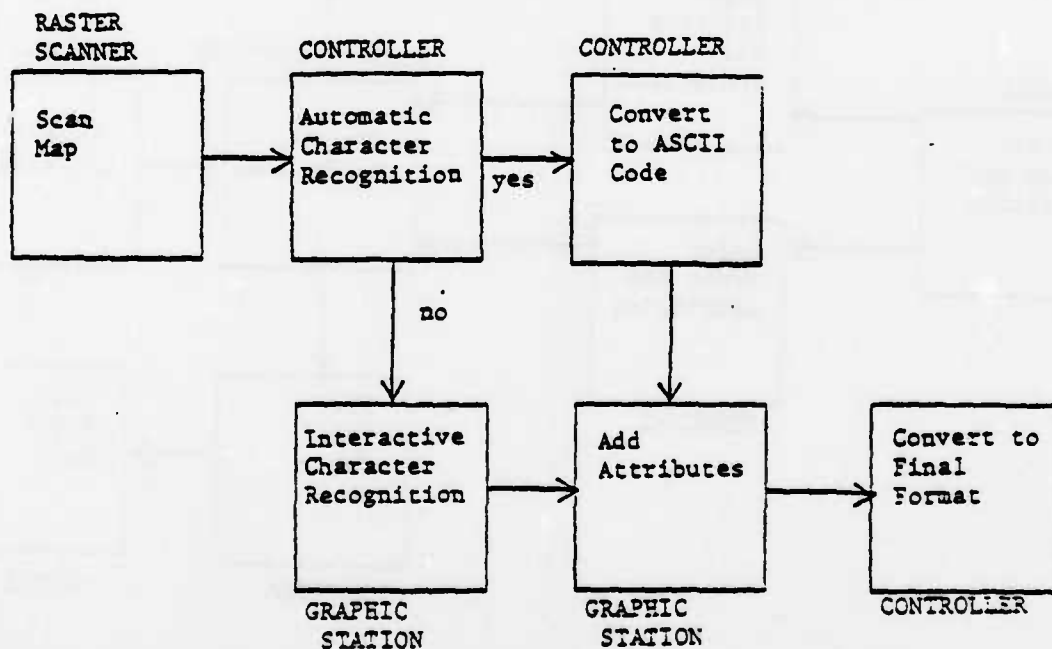
1.1.5 Interactive Plus - DMA Names Type File System

This prototype system was created to automate geographic names data entry, storage, manipulation, retrieval, and formatting. At the data entry level, the operator can manually enter names with full diacritics and associated information, digitize the position, and then plot the data on an overlay for editing. This system is not in production.



1.1.6 Automated/Interactive - Scitex and Intergraph (Australian Army)

In both of these prototype systems, the map separation plate or plates containing the names are scanned and the text image, position, and orientation are recorded. The pixel image is compared with a type font library. If recognition occurs, the ASCII representation of the character along with the position and orientation is put into the data base. If the text image cannot be read or recognized, interactive editing on either the Scitex or Intergraph workstations is necessary. Attributes such as area and feature codes are entered interactively in a subsequent operation.



1.2 Deficiencies of Existing Systems

1.2.1 Deficiencies of the Manual System

This input system is slow, very labor intensive, low resolution, and produces only a single product. The filling out of coding sheets is a technical approach favored in the punched-card era of the 1960s. It does not take advantage of manual digitizing of position or direct entry onto tape or disk of the names and attributes. The sole product, a listing, ignores the state-of-the-art advantages of proof overlays and interactive displays.

1.2.2 Deficiencies Manual Plus System

The major drawback of this approach is the large amounts of manual labor involved. This is mitigated by the fact that the effort was one-time, contracted, and subsidized under another government program.

1.2.3 Deficiencies of the Interactive System

The purchase of an Intergraph system solely for a geographic names entry project would not be an effective investment of capital. The Intergraph system is very expensive and provides many more capabilities than are needed for names entry. However, it must be presumed that the system was purchased for other, more complex applications and that its use for names is secondary. Aside from high capital costs, the only other noted deficiency is the requirement for linking. The separate recording operations require the assignment of a number so the names, attributes and position records can later be matched. This linking requirement, while admittedly not a major effort, is redundant.

1.2.4 Deficiencies of the Interactive Plus System (CIA)

The only defect here is the high capital cost for equipment. The linking step, used by the Chicago Aerial Survey System described above, is avoided.

1.2.5 Deficiencies of the Interactive Plus System (DMA)

The design of this prototype system addresses the different requirements for names entry. However, it has not been used for production and its deficiencies are unknown at this time.

1.2.6 Deficiencies of the Automated/Interactive System

The Scitex, like the Intergraph, represents a very major capital investment. This would represent a drawback only if there were no other major uses for the equipment. The major deficiency here would be the difficulty in relating the name to the position. Symbolized point locations would be the easiest to relate but unsymbolized point, linear, and areal features represent major hurdles. It is assumed that attributes and unsymbolized point locations would be either pre-assigned or added interactively later on.

1.3 System Function and Procedures

The Automatic Alphanumeric Data Entry System has the following eleven explicit functions:

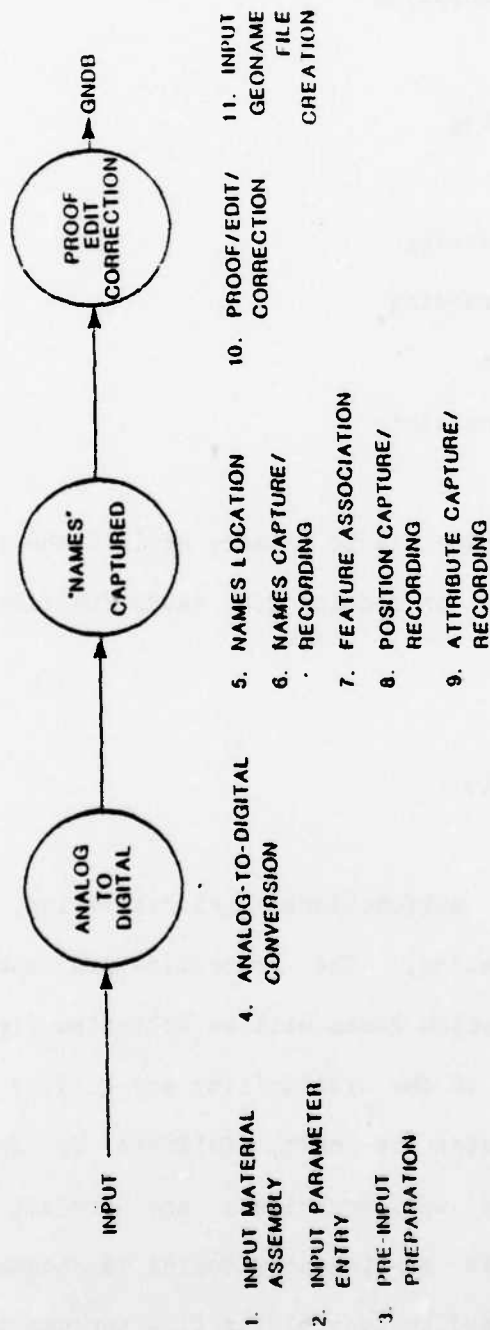
- o Input Material Assembly

- o Input Parameter Entry
- o Pre-input Preparation (Optional)
- o Analog-to-Digital Conversion
- o Names Recognition
- o Names Capture/Recording
- o Feature Association
- o Position Capture/Recording
- o Attribute Capture/Recording
- o Proof/Edit/Correction
- o Input Geoname File Creation

The purpose of this section is to briefly explain the individual functions. Each is explained in detail in Section 2.0, AADES Function Specifications. See Figure 1-1.

1.3.1 Input Material Assembly

This step has five subfunctions: prioritization, scheduling, assembly, organization, and accounting. The prioritization subfunction requires a management decision as to which names will be collected first. Implicit in this decision is the evaluation of the availability and quality of source documents. Scheduling of the processing is next, followed by assembly of the source materials. These must be well-organized, and project accounting must be performed throughout. This on-line bookkeeping is necessary given the immense processing volume and the need to control its flow through the eleven steps.



**FIGURE 1-1
AADES OVERVIEW**

1.3.2 Input Parameter Entry

This function establishes the parameters common to the project, permitting access to the appropriate code tables and rules. These parameters include title, projection, scale, language, product type, source, dates, classification, and type fonts. This information, once captured, triggers previously prepared rules and codes for particular diacritics, transliterations, and symbols.

1.3.3 Pre-Input Preparation

The preparation of the source data, and planning for subsequent phases, are carried out by this function. Within this phase, the name is selected, the position of the referenced feature is indicated, and the attributes are identified. The presence or absence of a symbol showing the location of the feature position is critical in this function, and the entry mode (manual, interactive, or automated) will dictate the extent of pre-selection.

1.3.4 Analog-to-Digital

The conversion of the analog data in map or overlay form to digital data is the next function. The geographic names, feature positions, and attributes are captured interactively using a keyboard, a hand-held OCR wand, a digitizer, a scanning cursor, or a combination of these. Optional routes in the automated mode depend on the map size and on the availability of separate symbol and name plates.

1.3.5 Names Recognition

This function involves locating and recognizing geonames. The automated approach searches for a character, determines if it is the first character in a string, orients the string, determines if the string is a word and then a name, and then transliterates it if the result is non-Roman or translates if it is an ideogram. Finally, the position of the name is noted. Manually the name is keyed in; interactively, an OCR wand can be utilized to read the name.

1.3.6 Names Capture/Recording

In the automated mode, the names previously recognized are entered into temporary file records in GNDB-specified formats. Following entry, both quantitative and qualitative checks are performed.

1.3.7 Feature Association

What feature is referred to by the captured name? Is there an explicit symbol, a boundary, or no symbol at all? These three conditions are dealt with here. The non-symbolized feature is most resistant to automated solution, but reversal of names-placement rules can be used for association.

1.3.8 Position Capture/Recording

Following feature association, the next function is to capture and record the position. Point, linear, and areal symbols and no symbol are four possible conditions. Rules for positioning vary, particularly among linear features, and the extent of natural areal features may be indeterminate.

1.3.9 Attribute Capture/Recording

The type font and symbols are both significant components in the capture of attributes. Populated places frequently have the population-size category and administrative function symbolized. Roads and streams have unique combinations of line weights, patterns, and colors that indicate classification. Similarly, type style, size, and extent denote the importance of area features.

1.3.10 Proof/Edit/Correction

Once the names, positions, and attributes have all been captured, the next function is verification. A readable overlay or overlays of the source map with all possible input data shown and a listing of the data is needed. These must be edited and then the file must be corrected.

1.3.11 Input Geoname File Creation

The final AADES functions is preparation for entry into the GNDB. This requires a final quality control check and final file generation. Transaction reports of the latter operation are needed for both the geonames and non-geoname information.

1.4 Terms and Definitions

AADES	- Automated Alphanumeric Data Entry System
accuracy	- the overall error in a measurement
analog-to-digital	- the process of converting graphic information into digital form
attribute	- defined characteristic of a feature
attribute value	- defined value of an attribute
centroid	- center of mass
diacritic	- a modifying mark near or through a character or combination of characters indicating a different phonetic value from an unmarked character
digitizer	- an analog-to-digital converter of graphic information
entity	- a geographic feature as it exists in the real world
feature	- a defined entity of interest that is not further subdivided
feature class	- a defined group of related entities of interest
font	- see type font
generic	- The portion of a geographic name that describes the type of feature represented
GNDB	- Geographic Names Data Base
hydrographic	- pertaining to water features of the landscape
hypsographic	- pertaining to surface features of the landscape (other than water)
ideogram, ideograph	- a picture or symbol in a system of writing which represents a thing or idea but not the particular word or phrase for that thing or idea
interactive mode	- a method that allows on-line man-machine communication
MBR	- minimum bounding rectangle

OCR	- optical character recognition
on-line	- actively connected to a host computer
point	- a zero-dimensional object which specifies geometric position by coordinate location
point-in-polygon	- the process of determining whether a given point (x, y coordinate pair) lies within a specified closed polygon
precision	- the closeness of measurements of the same phenomenon repeated under essentially the same conditions and using the same techniques
projection	- a systematic presentation of intersecting coordinate lines on a flat surface upon which features from the curved surface of the earth may be mapped
register	- to align two or more images
resolution	- the smallest unit of measure which can be detected
rule base	- data bases that are not merely files of uniform content, but that are collections of facts, inferences, and procedures corresponding to types of information needed for problem solution; consists of rules usually in an if-then or antecedent-consequent form
scanner	- a device that records an image in a series of regular movements along a series of parallel lines
separation	- single-color component of the map image
softcopy	- data stored in digital form
transliterate	- to represent or spell in the characters of another alphabet
type font	- a printing type face of a given style and size
voice entry	- a voice-to-digital conversion method
workstation	- an interactive device that can digitize, display, and edit graphic data

2.0 AADES FUNCTION SPECIFICATIONS

2.1 Detailed Functions and Process Flow

As previously outlined, the Automatic Alphanumeric Data Entry System has eleven components or functions:

1. Input Material Assembly
2. Input Parameters Entry
3. Pre-input Preparation (Optional)
4. Analog-to-Digital Conversion
5. Names Recognition
6. Names Capture/Recording
7. Feature Association
8. Position Capture/Recording
9. Attribute Capture/Recording
10. Proof/Edit/Correction
11. Input Geoname File Creation

Dividing AADES into eleven functions ensures that quality control and job management become an integral part of each function. Ensuring the output integrity of each system component simplifies the quality control and management of the system as a whole. The final quality check will create the Input Geoname File, which will conform to the input requirements and specifications of the Geographic Names Data Base (GNDB). See Appendix IV for the AADES-GNDB interface requirements.

The purpose of this section is to detail the function requirements and

process flow of each AADES component. A flow diagram and discussion elaborates each function.

Incorporating voice entry and OCR technology depends on the amount of risk that the AADES decision makers are willing to tolerate. The information available on the success of systems utilizing voice input/output (I/O) varies dramatically. Appendix V provides a list of voice I/O equipment manufacturers for investigation. The use of voice entry on the AADES would be included in the interactive mode of system components. Simple, often used commands could be entered through the voice input equipment instead of the keyboard or menu tablet. Again, this is an area which needs further investigation.

The Market Briefing (Data Item: A001) presented information on current optical character recognition technology. From the extremely sophisticated OCR systems such as the Graphix I of Information International Inc., to the hand-held wands, recognition accuracy is on the order of 98%. These are OCR systems developed for disciplines other than cartography. Most companies indicated they would need a sample map for trials and that their systems might be adapted to this application through software development. The performance of hand-held wands for reading names from maps can only be determined by tests.

Three companies (Scitex, Anatech, and Intergraph) claim OCR capabilities on their graphics workstations. These claims need verification.

Thus voice entry and OCR wands are not specifically addressed in the following sections. They may be considered as part of the interactive mode under appropriate functions. The employment of such technology is a management decision.

2.1.1 AADES Input Material Assembly

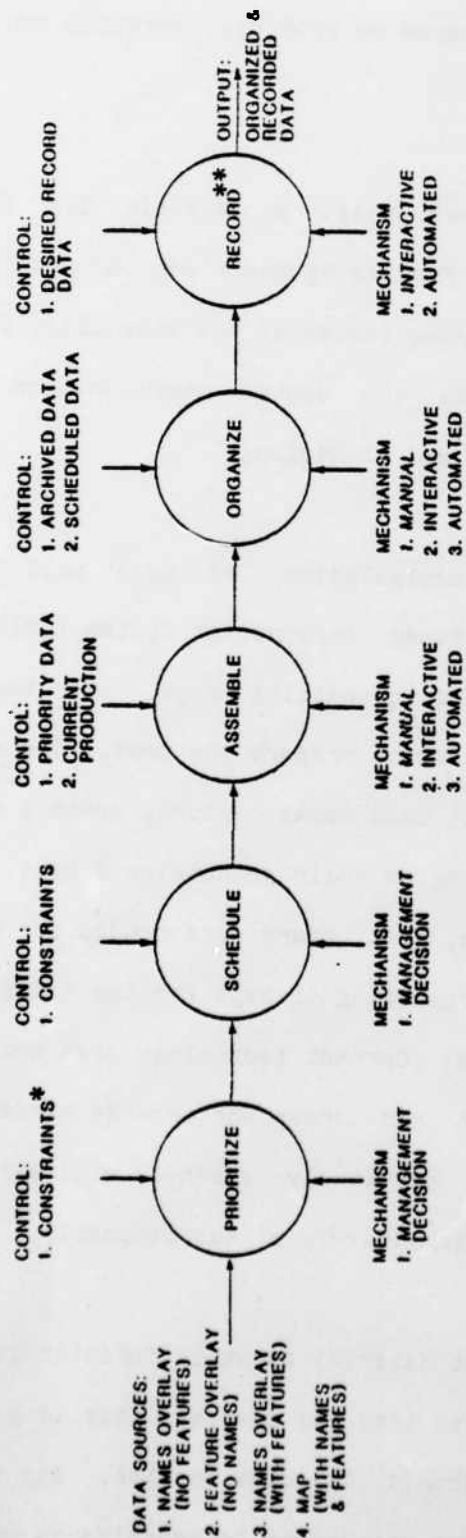
The purpose of this AADES component is to organize and make a record of the input data in preparation for subsequent processing (see Figure 2-1).

The factors constraining the data organization are:

1. technologic limitations
2. physical configuration restrictions
3. schedule
4. funding
5. political restrictions

With the possible exceptions of technologic limitations and physical configuration restrictions, these constraints are governed by DMA policy decisions. The first major decision is the course of processing. Will maps be processed at a fixed rate over a number of years or on some interval schedule related to map publications?

Priority of processing is also an agency decision. Perhaps the most standardized maps should be processed first, until the technology is available to handle unorthodox maps with no definable map construction standards. The prioritization might also consider capturing names in areas of strategic importance first. The demand for geographic information and for cartographic products in these areas will be highest. Because U.S.-produced maps (such as DMA JOG sheets) are most accessible, these series covering areas of interest should be processed first. Concurrent with the processing of U.S.-produced maps of areas of interest would be the assembling of maps from other sources. These



* CONSTRAINTS:

1. TECHNOLOGY LIMITATIONS
2. SCHEDULE
3. FUNDING
4. PHYSICAL CONFIGURATION RESTRICTIONS
5. POLITICAL RESTRICTIONS

** AS IN "BOOKKEEPING"
 NOT SCAN & CAPTURE

FIGURE 2-1
 INPUT MATERIAL ASSEMBLY

parallel activities would reduce total project time and offer a greater opportunity for automation if the map standards are established. These decisions, however, must be made by DMA based on product-generation requirements and available resources.

Once the above decisions have been made, a schedule for the actual processing of data can be constructed. Processing hours per day and the number of analysts monitoring the system are some issues of the scheduling function. These issues are contingent upon both the system configuration and the management decisions involving priorities and scheduling.

The physical assembling and manipulation of maps will be quite time-consuming. The USGS Geographic Names Information System (GNIS) project required many hours for assembling and organizing maps. For the State of Arkansas alone, the USGS spent forty hours to prepare the maps. The contracted company, which actually performed the data names capture, spent a subsequent twenty hours sorting the maps according to their processing scheme. Thus for the USGS maps of the state of Arkansas, sixty hours were needed for assembling and organizing. The assembling and organizing of maps for the AADES, like the GNIS, is predominantly a manual process. Current technology does not provide a flexible automatic map "handler" that can order and arrange hardcopy maps. However, some input maps which were previously scanned will already be in digital form and these will be sorted interactively or automatically.

The final step of the AADES Input Material Assembly function is to make a record of the data about to be entered into the system. This is a simple but crucial bookkeeping function which should be done on-line. Any information recorded at this stage, which duplicates map legend information to be captured

during the Input Parameters Entry stage, will be tagged and routed at the appropriate time by the software.

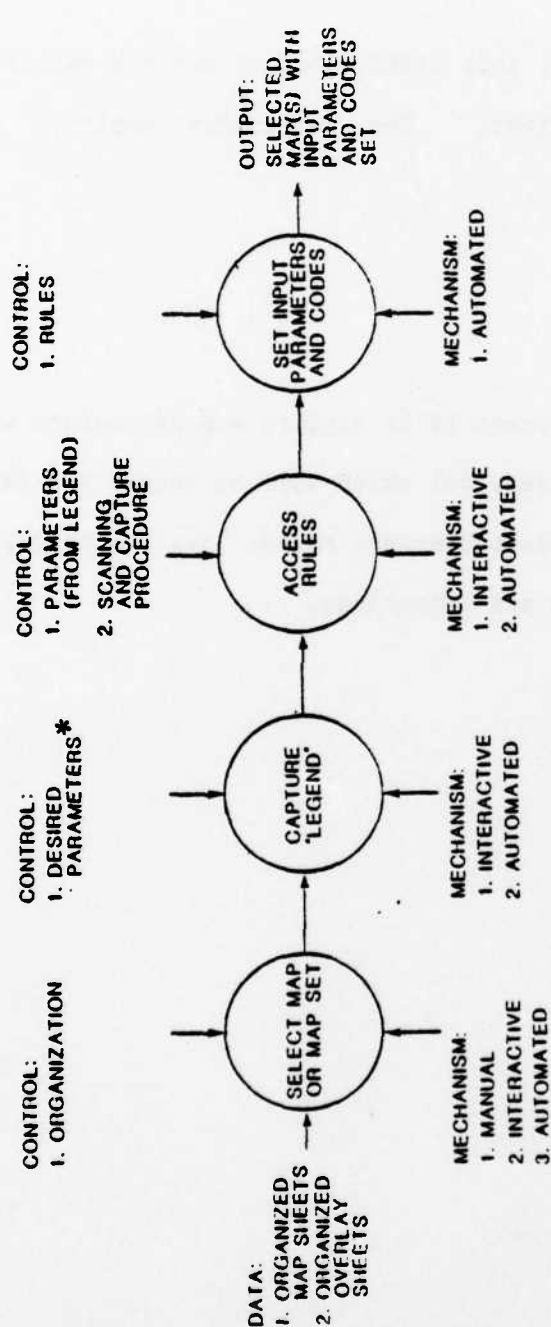
More than the other components, this AADES function and its specifications are dependent on policy decisions. The mechanisms employed will be predominantly manual.

2.1.2 AADES Input Parameters Entry

The function of this AADES component is to capture map parameters which are not only important in and of themselves, but which will be needed for setting up automatic access to appropriate code tables and rules. See Figure 2-2 for the process flow with delineated controls and mechanisms.

The parameters of interest are:

1. title
2. projection
3. scale
4. language information
5. product type
6. publisher
7. date:
 - of map
 - of AADES processing
8. classification
9. type font and size



*** PARAMETERS :**

1. TITLE
2. PROJECTION
3. SCALE
4. LANGUAGES/TRANSLITERATION USED...
5. PRODUCT TYPE
6. PUBLISHER SOURCE
7. DATE OF MAP AND OF AADES PROCESSING
8. CLASSIFICATION
9. FONT STYLE AND SIZE

FIGURE 2-2
INPUT PARAMETER ENTRY
"CODE SETUP"

There may be other parameters of interest in special cases, but required information has been kept to a minimum to avoid a cumbersome data base.

Each of the parameters captured when making a record of the assembled input data during the previous stage is automatically inserted in the legend file by the software. For example, if it was noted that the next fifty maps to be entered were 1:24,000 USGS maps, this information would not need to be recaptured.

Most map series conform to some defined font and symbolization standards. See Appendix I. For highly standardized maps such as the DMA JOG sheets, deduction rules may be written to automate parts of the name-feature-attribute recognition and association stages. The parameters captured from the legend will switch on the appropriate sets of rules. At the character location and identification phases (part of NAME RECOGNITION), these rules will be activated to automatically deduce the feature and attribute information associated with the name from the font used. This information will be entered in the appropriate record fields.

Rules can only be written after thorough analysis of map products. Not only will the initial map production process need to be investigated, but all the fonts need to be recorded with respect to what feature and attribute information they reflect. (Note: In a future DMA digital map production environment, these rules will be encoded to permit automated map compilation and symbolization. These existing rules could then be used for names data capture.)

The ACCESS RULES phase simply switches on or initializes the appropriate sets of rules. The SET INPUT PARAMETERS AND CODES phase initializes the diacritic code tables, transliteration scheme, and symbol/feature codes to be used for the map(s) being processed. There is an interactive option for analyst intervention.

2.1.3 AADES Pre-Input Preparation

The purpose of this function is to prepare the source data and to plan for the following steps of capturing names information. The name to be entered must be selected, the feature position indicated, and the attribute identified. This preparation will necessarily vary with the mechanism employed: manual, interactive, or automated. The position of the feature may or may not be symbolized and, in the case of areal or linear features, off-map conditions may be significant. Names with similar attributes may be profitably grouped beforehand by feature (for example, all rivers), by administrative area (such as all Colorado), by population rank, or by other attributes. Pre-input preparation can eliminate many redundant names and enhance the tagging of attributes and positioning of features. See Figure 2-3.

While the name selection rules encountered vary, certain ones generally apply. Point names do not include the feature (such "village") unless it is first and unnamed features (such as "spring" or "trailer park") are not collected. River names are captured only once on a map although they appear many times. Other rules might limit the selection to names found within the map neatline and to specified features. In the manual and sometimes in the interactive mode, a notation of the name selected is made either on the map or on the overlay. In the automated mode, all text is captured and then screened

for color or type styles. The rules for such selection are made at this stage but are carried out later.

The next stage of pre-input preparation is dependent on the presence or absence of symbols locating the feature position. In the first condition, where symbols are present, the rules vary with feature type. Point features, such as small populated places, administrative centers, and railroad stations, are located by the symbol center. Bounded areal features, like incorporated towns and lakes, are positioned by a center within the boundaries and generalized boundary points (MBR). If the largest part of an areal feature occurs off the map, the center position should be so indicated. Linear feature rules vary with the type of feature. The primary entry for a river is normally the stream mouth; secondary ones may be used for the source, entrance and exit points on a map sheet, significant points elsewhere on the course, and the MBR. Such multiple orientation is critical to the type placement process. The manual and interactive modes utilize notation on the map or overlay to indicate desired position. The automated approach requires planning for the recognition and positional relationship of specific symbols.

If no symbol is present, the specification of a position is dependent on the characteristics of the feature. Locale names usually are first referenced to the center of any group of buildings in the vicinity, secondly to a crossroad, and lastly to the center of the name. Other areal features, like bays, forests, and deserts are centered on the name. The "off-map" rule for areal features, previously described, also applies. Annotation of the selected position is used in the manual mode and optionally in the interactive approach. However, in the automated mode the specification of an unsymbolized name position is limited. By recognizing specific type fonts, generics as part of

the name, and symbols on other plate separations, some positions could be derived. The effort involved in this process might not be cost-effective.

Attributes represent the final phase of pre-input preparation. Grouping common elements can facilitate the input of required attributes. Popular strategies to accomplish this include the use of plate separations to group hydrographic, hypsographic, and populated place names and the use of classification by common type font and symbol. For example, populated places of one county appearing on the culture plate might be entered sequentially based on their symbolized population or administrative rank. Such planning would be effective for manual and interactive entry and, possibly, also for the automated mode.

2.1.4 AADES Analog-to-Digital

The function of this AADES component is to convert the input data from analog to digital form. See Figure 2-4.

The actual conversion process may be of the whole map sheet or only of the information of interest. The former option involves a raster scan process which digitizes the whole map. The latter involves some selective process such as an analyst entering the information at a keyboard or selective scanning.

Both options are provided on this system. The interactive selective capture serves as a backup to the higher-risk technology of the raster scan option. The selective capture avoids subsequent processing problems such as automatic name location-identification-recognition and feature association, but presents problems in that it is extremely labor-intensive. This manual or

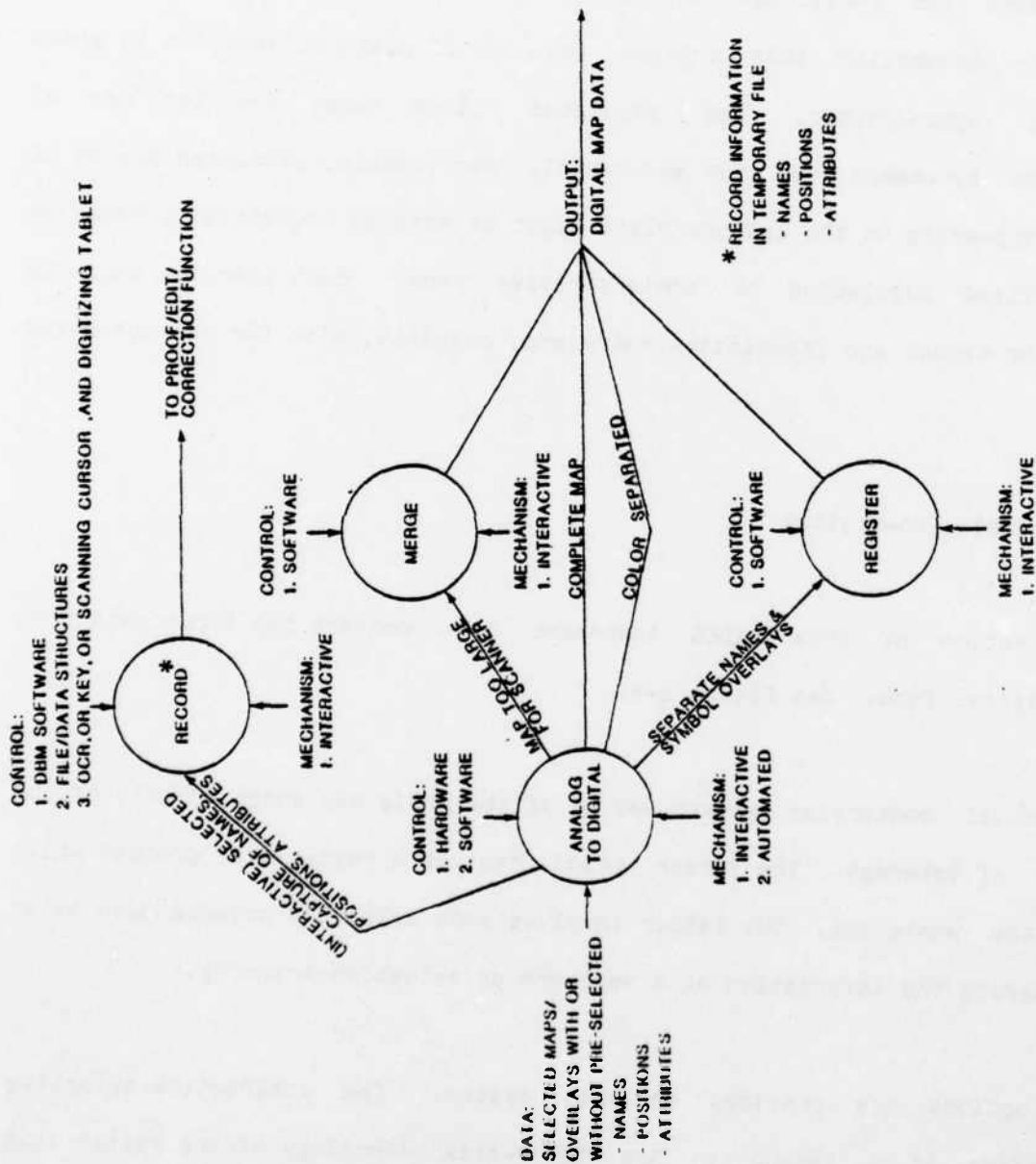


FIGURE 2-4
ANALOG-TO-DIGITAL

selective capture approach is the approach selected by the USGS for their GNIS project.

For the selective capture process, names can be entered into the system by an operator at a keyboard, by a hand-held OCR (optical character recognition) wand or by a scanning cursor. Those methods would be used in conjunction with a digitizing tablet for position capture. The keyboard option has a very low technical risk but is conducive to errors resulting from analyst fatigue. The hand-held OCR wand option represents a more automated approach and a higher technical risk factor. Although word identification and orientation is not a problem as it is with more automated techniques, hand-held wands can require multiple passes for word capture. There are some very sophisticated OCR wands, but the use of wands for names capture from maps has not been demonstrated. A successful OCR scan with a hand-held wand requires even pressure and steady motion of the hand and may be hindered by background noise.

Analog-to-digital conversion of the whole map is a task easily accomplished by today's technology. If the map is physically too large for the scanner, it will be scanned in sections and then merged into one file by the software. Analog-to-digital scanner systems will accept maps of varying size and varying material types. The system will provide the necessary hardware and the software for controlling the different analog-to-digital conversion processes required by these different map products. The three basic map products to be processed are:

1. the complete map converted from analog form to a digital
file
2. the complete map converted from analog to color-separated

digital files

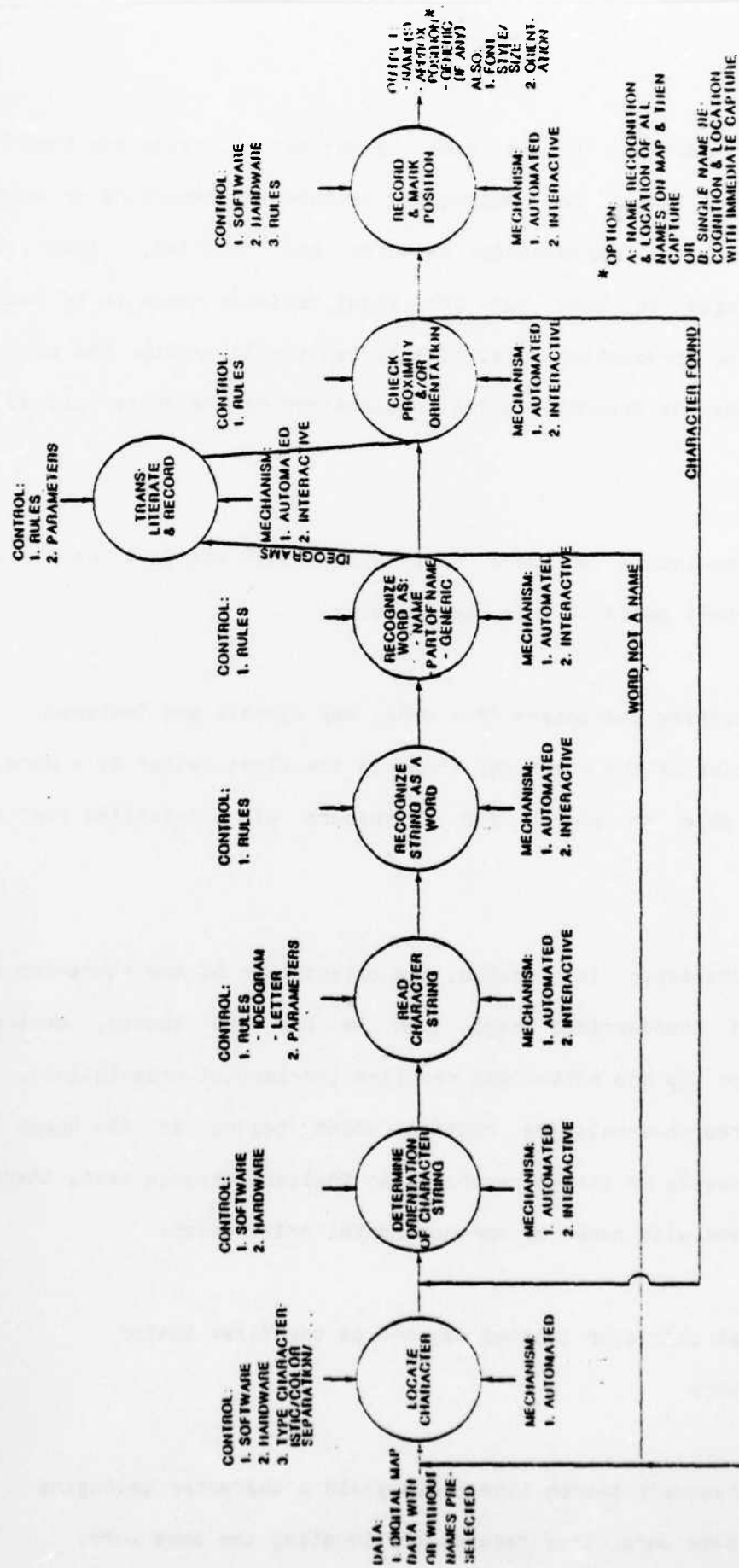
3. separate names and symbols overlays of the same map converted from analog form to digital files

The actual analog-to-digital conversion process will be governed by the hardware selected. The product being processed and the original system constraints will determine whether or not the selective capture of names or the whole map conversion is required.

2.1.5 AADES Names Recognition

The purpose of this AADES component is to recognize the geoname. This function involves location, identification, and recognition of the geoname. The automated, interactive, and manual approaches to this names recognition function will be discussed. The automated approach will be discussed first because it is the most desirable and represents the highest technical risk. See Figure 2-5.

The initial decision made in this function is whether all names of a specified type font will be located and processed together or whether the first name found, regardless of font, will be processed. The advantage of locating all names, based on font, is that certain parameters for feature type and attribute information can be preset. This will cut down the number of rules to be run for each name, reducing processing time. The disadvantage of this processing option is that the digital map data must be processed many times: as many times as there are different fonts. Trial AADES production runs are needed for an efficiency comparison of these two approaches.



FROM NAMES CAPTURE/RECORDING FUNCTION

FIGURE 2-5
NAMES RECOGNITION (AUTOMATED)

The second decision to be made is whether all names and their relative positions will be noted for subsequent capture and recording or whether each name located will be immediately captured and recorded. Again, there are relative advantages to both but the final decision needs to be based on the results of trial production runs. The system should provide the above options so that test runs may determine which combinations of the above options are most efficient.

A search-and-locate software routine will scan the data until a character is found. Important parts of this routine are:

1. distinguishing characters from other map symbols and features,
2. determining if the character found is the first letter of a word, and
3. being able to search for characters of a specified font and/or to determine font.

After a character is located, the orientation of the character string is determined. On standardized maps such as DMA JOG sheets, most names are parallel to the top and bottom map neatline (horizontal orientation). Assuming a systematic search-and-locate routine which begins in the upper left-hand corner and proceeds as though recording an English-language text, there will be two major problems with names of non-horizontal orientation:

1. the first character located may not be the first letter
of the word
2. each subsequent search line could yield a character belonging
to the same word, thus redundantly locating the same word.

Varying character orientation within one name, such as along winding rivers, will present problems for automated processing. However, knowledge of the feature's shape in the vicinity of the name will assist in assembling the characters that make up the name.

After the character location and character-string orientation have been determined, the string is read into the system. Once entered, the appropriate rules are used to determine whether the string is a word and whether the word is a name, a part of a name, or a generic name. At this point there are several options:

1. if the word is not a name, proceed to locate next character not in that name and repeat the routines,
2. if the word is a non-Romanized name, the appropriate transliteration scheme is automatically activated and the transliterated version is also captured, or
3. proceed to the next process, which is a proximity check for additional characters which may indicate part of a name or a generic name.

If the CHECK PROXIMITY AND/OR ORIENTATION routine yields evidence of a second word, then the system loops back to DETERMINE ORIENTATION OF CHARACTER STRING and repeats routines. If no evidence of a second word is found, then the system proceeds to RECORD AND MARK POSITION.

The output of this Names Recognition (Automated) component of AADES is:

1. names,
2. approximate position,
3. generic word (if present),
4. type font, and
5. orientation.

The Names Recognition function (Interactive/Manual) provides several options. See Figure 2-6. After the analog-to-digital conversion of the whole map, the digital map data is displayed. The map will most likely be displayed one section at a time. The analyst locates the section for processing through scroll or roam routines of the display function. In the manual mode, the operator will type in the name and associated feature or attribute information at a keyboard. In the interactive mode, the analyst will place a cursor on the first character of a word and then an OCR routine will automatically read the character string. Both these options are followed by position capture. This may be done manually, interactively, or automatically, depending on the sophistication of system software and hardware. The output of this Names Recognition option is the same as for the automatic option discussed previously. The manual mode obviously represents no technical risk other than human error and non-objectivity. The interactive mode's technical risk will largely depend on the OCR software.

2.1.6 AADES Names Capture/Recording

The function of this AADES component is to capture and record the actual geonames in the correct data fields. See Figure 2-7.

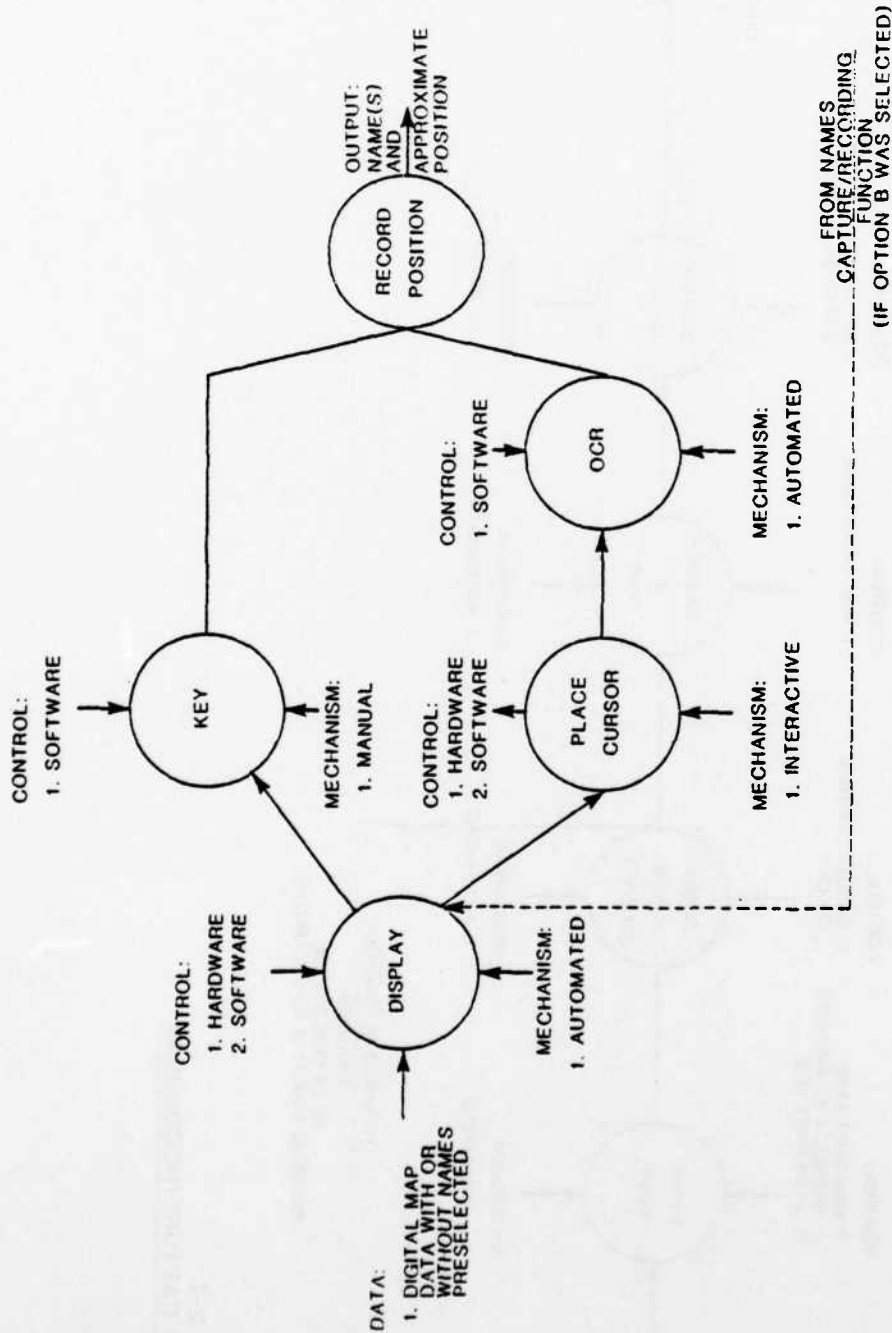


FIGURE 2-6
NAMES RECOGNITION (INTERACTIVE/MANUAL)

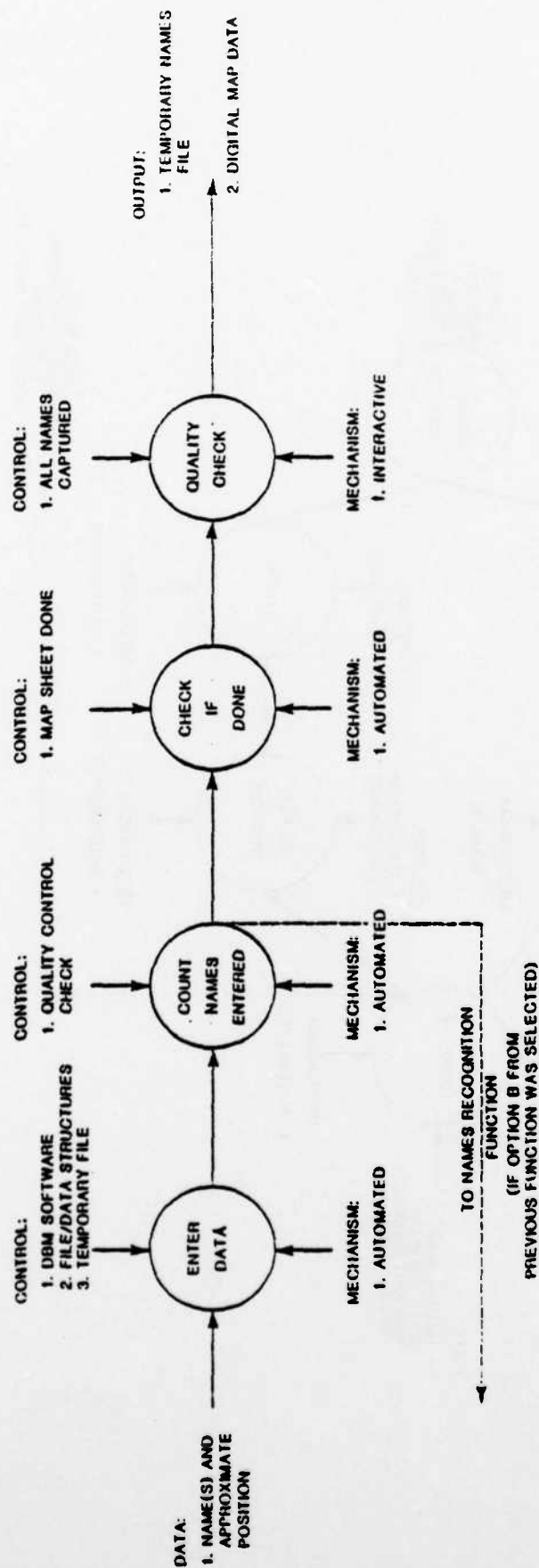


FIGURE 2-7
NAMES CAPTURE/RECORDING

Regardless of whether the Names Recognition was manual or automatic, the names recognized are entered into the temporary names file at the ENTER DATA stage. The names will be entered into record fields of GNDB-specified format and length. Although this names file is temporary, it will mimic the final Input Geoname File, thus reducing unnecessary file reformatting. See Appendix IV for preliminary-GNDB specified information on records.

As each name and its associated information is entered, a simple count will be kept. This COUNT NAMES ENTERED will be used as a check during later stages. If there were fifty names captured then there should be fifty feature records. A simple count balance provides an initial processing check.

The CHECK IF DONE stage provides several routines depending on the processing method (such as names captured according to font class, or names captured individually immediately after location). Depending on the method, this stage simply determines if the map is completed or if additional names need to be captured.

The QUALITY CHECK is a file inspection routine at this stage. This checks if appropriate records are created and fields occupied. Errors found at this stage will be corrected interactively by the analyst before proceeding to the next stage.

The output of this AADES component is a temporary names file and the processed digital map data, which will be used for additional feature, attribute, and position processing.

2.1.7 AADES Feature Association

The objective of this function is to associate captured names with features present on a map(s). The step is needed to ensure accurate position identification and to permit the capture of descriptive information associated with the named feature. See Figure 2-8.

For populated places represented on the map by a point symbol, feature association involves detecting the symbol most likely to correspond to a previously captured populated place name. (In the process of names capture it may be possible to identify the feature type that the name refers to based on font, color, or other characteristics of the lettering.) Reverse application of cartographic rules for placement of names around a point symbol will allow the system to immediately check the preferred or most likely location for the corresponding point symbol. The use of leader lines requires searching for such a line and following the line to its endpoint close to the point symbol.

Point symbols for populated places used in DMA and external map products (see Appendix II for example) include open circles, filled circles of various sizes, and special symbols (such as stars) for cities with administrative importance (for example capitols). Template matching and correlation techniques can be used to recognize the particular point symbol found. Consistency checks will be used to evaluate the appropriateness of the detected symbol given the font characteristics of the associated name.

The association of names with linear features (such as rivers) again must apply the rules for placement of such names in reverse. Proximity searches for the nearest feature of the appropriate type must be used together with analysis

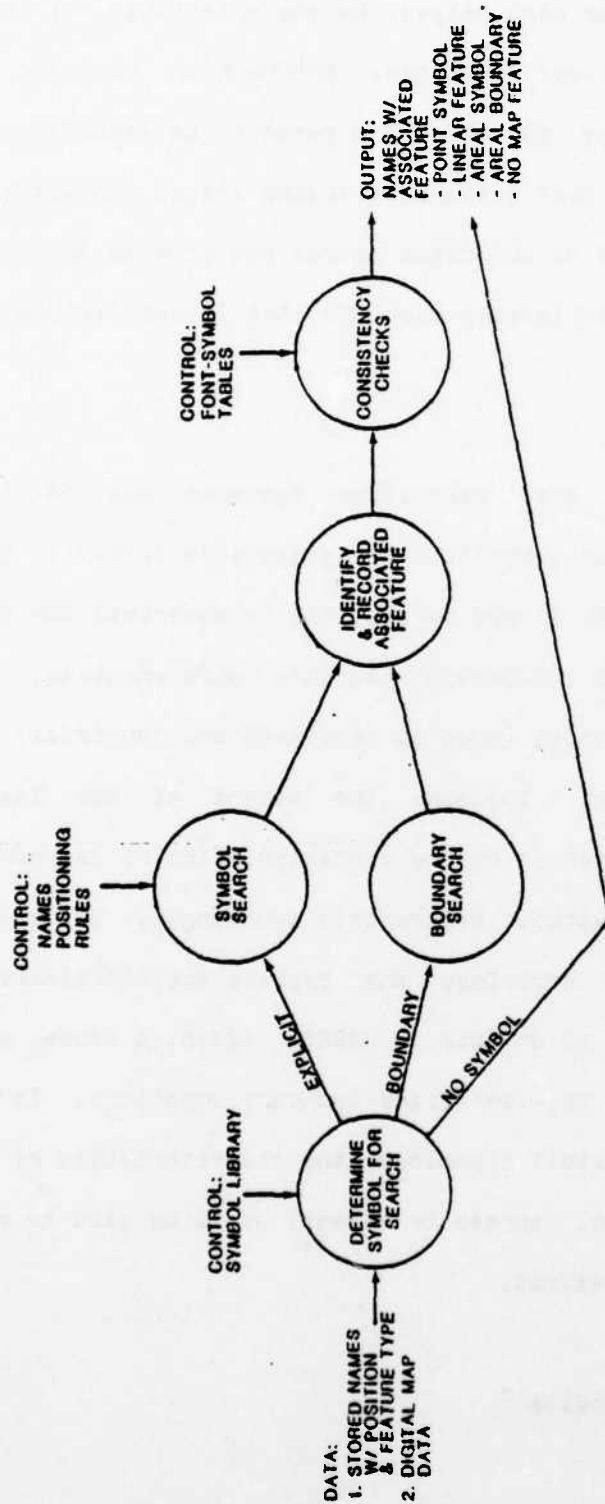


FIGURE 2-8
FEATURE ASSOCIATION

of the orientation of the name with respect to the orientation of the linear feature. As with point-symbolized features, information relating to the specific type of linear feature for which the function is searching may have already been supplied by the Name Capture/Recording stage. Knowledge of the particular map product being used as the input source can produce information on the specific nature of the symbolization used for that linear feature (such as roads or railroads).

Feature association for area symbolized features may be the most problematic. When the feature is symbolized using specific area-fill symbology (for example, swamps and lakes), it may be possible to ascertain the extent of the feature and create a crude (temporary) boundary representation. In other cases, especially for political units (such as provinces and countries) there is no explicit area symbolization. Instead, the extent of the feature is represented by explicit boundaries or by the characteristics of the name itself (for example, a mountain range without hypsometric symbology). While it may be feasible to recognize boundary symbology and capture the coordinates of the boundary, it may be impractical to do this in AADES. Again, a crude, estimated boundary could be developed from key-identified boundary locations. In the case of areal features without explicit symbology, the characteristics of the name (size of lettering, orientation, spread or extent) would be used to create an estimate of feature location and extent.

2.1.8 AADES Position Capture/Recording

The assigned position(s) of a geographic name must represent the position(s) of the feature associated with that name. Depending on the type of feature under consideration and the way that feature is symbolized on the input

map source, different strategies for defining name position(s) may be used. See Figure 2-9. Table 2-1 summarizes recommended position capture rules for different feature categories.

For a point feature symbolized with a single point symbol (such as a populated place represented by an open circle), the center of that symbol may be taken as the feature's approximate position.

For linear features (including streams represented by single-line symbols or by double-line symbols) the start and end point of the feature will be determined and recorded. For linear features that extend beyond the current input map's borders, the point where the feature enters and/or leaves the map will be determined and recorded. Some linear features, especially rivers but also including some roads, have multiple names for a single feature; that is, there are different names for subsections of the same feature. Multiple occurrences of identical names that are associated with the same feature can be eliminated from the active names file. Different names that are associated with the same feature (on the same map) will be saved and, initially, given the same positional identifiers. Human intervention will probably be necessary to define the segments of linear features to which particular names refer. In some cases, knowledge of national boundaries and/or language boundaries may allow automated procedures to be developed.

In network-type linear features, it is sometimes difficult to determine where a particular named feature begins and ends. In stream networks, there are rules for deciding which branch the main stream (and its name) takes at junctions. Some branches of named streams may be unnamed; it is important to note that these branches do not carry the name of the main stream.

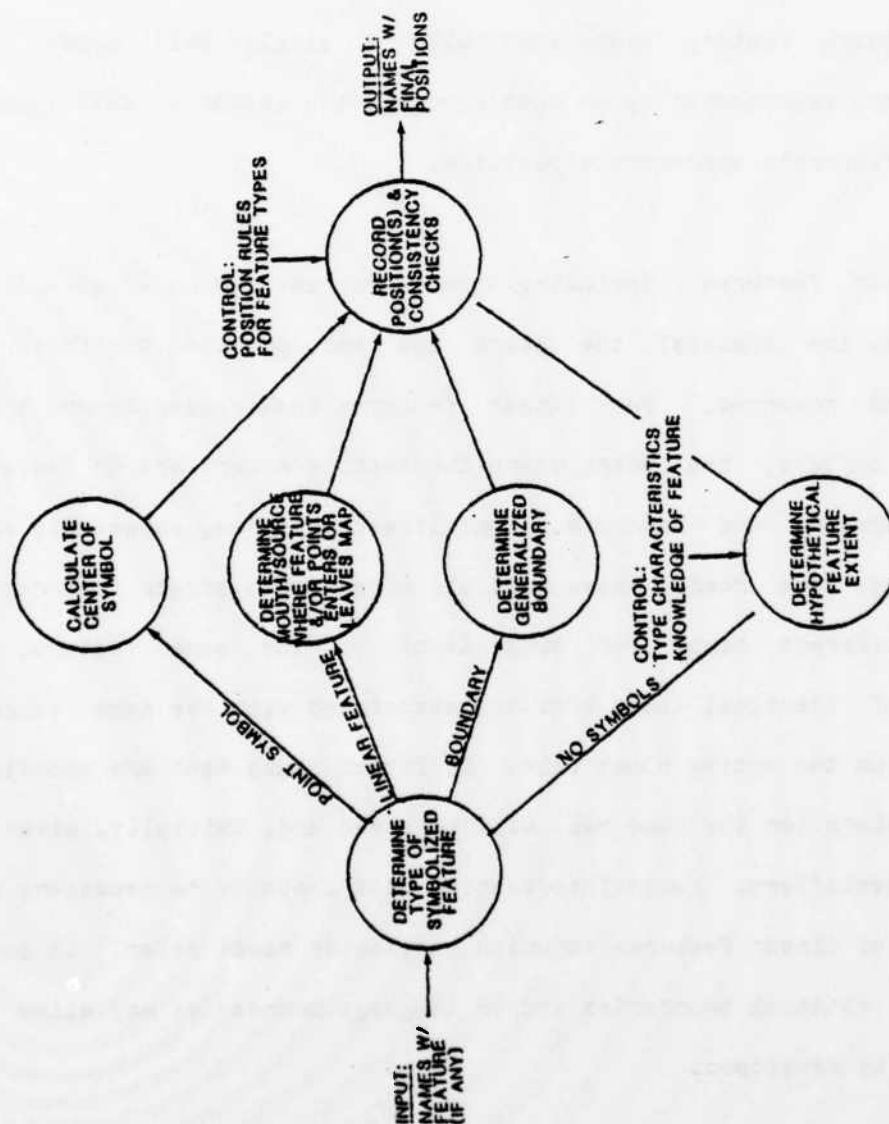


FIGURE 2-9
POSITION CAPTURE/RECORDING

Table 2-1 Position Capture Rules

<u>Symbolization</u>	<u>Position Information</u>
Point	1. Location of point symbol (center)
Line	<ol style="list-style-type: none"> 1. Start (source) of feature 2. End (mouth) of feature 3. Location(s) of feature intersection with map boundary (all as applicable)
Area	<ol style="list-style-type: none"> 1. Centroid 2. Generalized boundary points (MBR) 3. Intersections with map boundary

Computer-assisted techniques to identify the name associated with the appropriate network segments which do not have explicit names may be feasible. This must be investigated further using specific map products to evaluate the degree and nature of problems to be encountered in this process.

For area features represented by explicit areal symbology (such as color fills and swamp symbols), the extent of the symbol can be defined by determining key positions along the edge of the symbol. This will result in a generalized boundary for that feature consisting of, at most, a fixed number of coordinate pairs (eight, for example). Alternatively, a minimum bounding rectangle (MBR) can be calculated to describe the general extent of the area feature. Subsequently, an area centroid will be calculated and recorded. Certain area features, especially some natural features (such as named swamps, deserts, or bogs), may consist of more than one region or polygon. More than one centroid (or boundary file) may then be recorded and associated with the same name. Island chains would need to be represented as a polygon that includes all (or most) of the islands in the chain, without attention to the position of individual islands. Those individual islands that are named will, of course, have their own entry in the names file.

Political features (such as countries and provinces) are usually represented by boundary symbols without any area-filling symbology. Thus, these boundaries must be detected and associated with their corresponding names to generate accurate positional information. In the feature association process, the correct boundary can be identified using the font characteristics of the political feature name to define the kind of political entity it refers to. Then, a point-in-polygon routine can assemble the appropriate boundary segments that surround the name (or its center). Once the boundary has been identified,

a generalized version will be generated and recorded, along with a centroid. When the feature extends off the input map, this occurrence will be noted and the points at which the boundary enters and leaves the map will be recorded.

Certain names may not be associated with any explicit symbol. Natural features such as mountain ranges, informal regional entities (such as the Piedmont or the Great Basin) can have undefined boundaries. These are represented on maps exclusively by their names. The extent of the feature must then be surmised from the type font, orientation, and spacing of the name, and from the multiple occurrences of that name on the input map and adjacent maps. Rules to define a rectangle or an ellipse based on name characteristics can be implemented. When multiple occurrences of the same name are present on the same map, a single geometric figure that includes all of the instances of the name may be defined. This procedure assumes that such features are continuous and do not consist of multiple regions.

2.1.9 AADES Attribute Capture/Recording

See Figure 2-10. The type fonts and symbols associated with features provide attribute information that can be captured by AADES. Probably the most important class of such attributes is importance descriptors for populated places. The aspects of town importance that may be symbolized on maps include: population size categories, administrative functions (national capitol, provincial capitol), and military or strategic importance. Population size categories may be represented on maps by the size of the lettering, the size or style of the point symbol or the size of the area symbol (for cities represented by a boundary and/or area-fill symbolization). As previously stated, type font information will be captured in the initial stages of name recognition; rules relating this information to population size classes will be used to generate population size estimates. Symbol size and style information is captured in the feature association segment of AADES. Again, rules will be developed to relate symbol size and style to population class for those map products that use this type of symbolization procedure.

Administrative importance is also represented on maps using a variety of symbolization techniques. Special point symbols (such as stars, filled circles, and squares) may indicate an administrative function associated with a town and the nature of that function. The use of a symbol library and a table associating symbols with their meaning will allow for the interpretation of such special symbols. Another method sometimes used to designate towns with administrative importance is the underlining of the name of the town. The presence or absence of an underline (in maps known to utilize this method of symbolization) can be determined either during the Names Recognition stage or as a post-recognition activity during symbol search (Feature Association). Again,

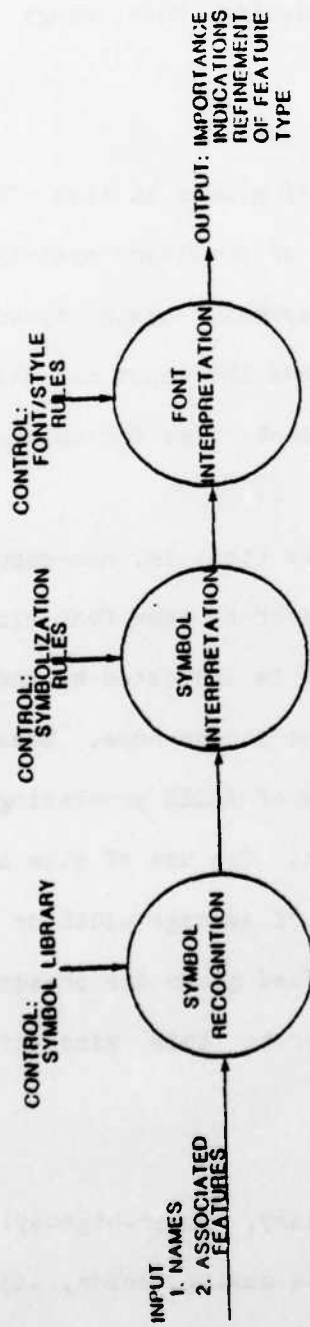


FIGURE 2-10
ATTRIBUTE CAPTURE/RECORDING

information on type fonts, color, and other methods of indicating administrative importance using the name itself will be captured at the time of name recognition and will be interpreted during this stage of the AADES processing.

The military or strategic significance of places is also often symbolized through the use of special point symbols or auxiliary symbols adjacent to, below, or above the place name or its point symbol. Again, symbol recognition and interpretation are feasible, assuming that the input map has a relatively small number of readable symbols and has consistent rules for using them.

Importance attributes for other features (that is, non-populated places) may also be represented by symbolization and/or by name font size and style. For example, the importance or size of streams is indicated by the width of the stream and by the size of the lettering of the stream name. Because type font information is readily available at this stage of AADES processing, it would be used as much as possible in size designation. The use of size and importance derivation algorithms (such as the calculation of average width or total length) is certainly feasible but may not be justified given the presence of spatial data bases that would be designed to generate this kind of information efficiently.

The class of roads (primary, secondary, super-highway) is usually represented by unique line symbols (e.g., double casing, color, width of line). Adequate symbol libraries and interpretation rules will allow for the capture of this kind of information for named roads. In some cases, a feature name may be available on the map (such as "autobahn") that will indicate the road's class. In many countries, specific roads are designated on maps using numbers and/or

special symbols that may surround the numbers such as U.S. interstate highway symbols and numbers). These identifiers can be recognized and recorded in much the same way as special text characters or diacritics. Rules would permit the translation of these symbols into text descriptors (such as Bavaria Provincial Route 73 Germany).

The importance of area features such as forests and mountain ranges is indicated by the type font and the areal extent of the feature itself. Because the extent of symbolized area features is estimated and represented by a generalized boundary in the Position Capture function, estimated area calculation can be easily accomplished for such features. Broad categories of area feature size could then be recorded for these features. Type font information is also available and will be used, when possible, to denote feature importance.

One of the most useful indicators of feature importance from the perspective of names selection is also the easiest to capture. Knowledge of the kind of map (scale, product type) on which the name appears will indicate, for future map production, the kind of product on which it may be appropriate to use that name and feature. As described above, this information is captured and recorded in the Map Parameters Entry stage of AADES processing. Whenever possible, attributes that apply to all or most of the features on an input map (such as the country or province that features are in) will also be captured and recorded as a pre-processing step or through operator control of processing order.

2.1.10 AADES Proof/Edit/Correction

The purpose of this function is to produce both a proof map and a listing for editing and correction. See Figure 2-11. The proof, on transparent stock, is used to overlay the source map. The content of the proof must include sufficient registration marks, the names, the position of the named feature, and some indication of the feature type. Color is frequently employed to show different feature classes (populated places — red, hydrography — blue, hypsography-brown, etc.). The proof, of course, must match the projection and scale of the source map. Also required is a listing of the entire record associated with each name. This may list the names alphabetically either for the entire map or within quadrants or smaller sectors in the case of a map with many names.

The manual edit step compares the overlay with the source map. The first checks are cursory. Does the overlay register or is there a scale or projection error? Is there an overlay name for every source name? Is the selection of names and positions consistent? These initial checks can be made quickly, while subsequent ones must painstakingly compare each name, position, and attribute. A count of the number of names recorded will be a useful check for completeness. Name corrections and omissions are noted on the listing and position changes on the overlay.

The correction step requires a decision. If the changes are many, the processing should be redone. If the changes are nominal, then the data base record alterations can be made interactively or entered in batch mode. Corrections of position can also be done interactively or batched from an off-line digitizer.

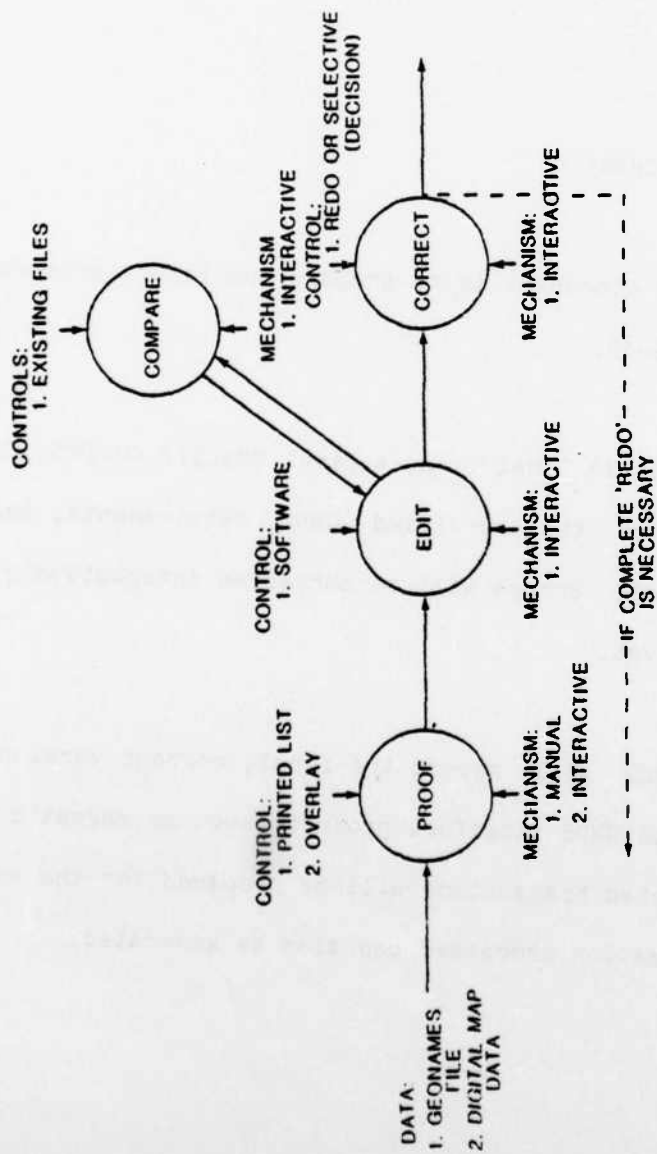


FIGURE 2-11
PROOF/EDIT/CORRECTION

This Proof/Edit/Correction function, while mandatory just before entry into the GNDB, can also be used effectively in the initial Input Material Assembly function. By proofing names already in the data base and comparing with the source map before processing, a prediction of the potential return from processing can be made.

2.1.11 AADES Input Geoname File Creation

The function of this AADES component is to prepare the final geonames input file for the GNDB. See Figure 2-12.

Before the geonames file is in final form, a final QUALITY CONTROL CHECK is performed. Again, depending on the specified GNDB requirements, the files records and fields are inspected. Errors will be corrected interactively at the graphics workstation by an analyst.

The CREATE FILE FOR GNDB will record the final, correct version of the geonames file on the specified GNDB interface product (such as magnetic tape or disk). A report on the completed transaction will be prepared for the analyst. A report on non-geonames information processed can also be generated.

2.2 Job Management

The job management function controls the initiation and termination both of jobs and of processes within jobs. This is the most basic and highest level function of any system. The primary action of job management is to interpret job control commands for:

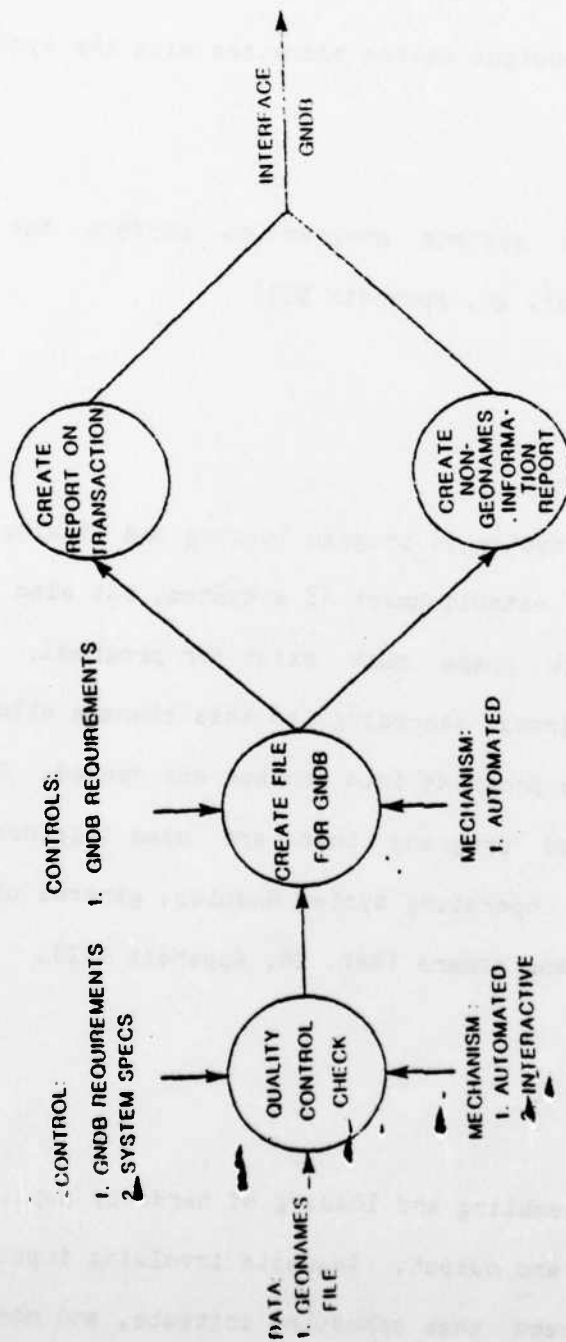


FIGURE 2-12
INPUT GEONAME FILE CREATION

1. establishing and terminating accounting procedures for a job,
2. associating actual input-output device addresses with the symbolic ones employed in the job, and
3. invoking the appropriate systems program to perform the task requested by a job process (Ref. 26, Appendix VII)

2.3 Program Loading and Linking

A necessary function of any system is program loading and linking. This is not only required for the initial establishment of a system, but also for system enhancements. Sufficient storage space must exist for programs. Relocation functions for manipulating programs according to this storage allocation and load functions for loading these programs into storage are needed. The ability to link independently translated programs that are used together must also exist. These programs include operating system modules, general user library functions, user object programs, and others (Ref. 26, Appendix VII).

2.4 Input-Output Control

Except for the physical assembling and loading of hardcopy maps, the system will be responsible for input and output. Requests involving input and output are directed to systems programs that schedule, initiate, and monitor system operations. Device and auxiliary storage allocation, and software buffering, are examples of input-output control functions. Centralizing input-output control increases both system efficiency and protection. It also removes the

tedious details of input-output programming from the user.

2.5 Operating System

Operating system functions provide services to the user and control and allocate the system resources efficiently. The system must consist of a set of interacting processes communicating through common data structures to perform process, resource, and file management for the user and for the system itself. The actual structure of the operating system depends on the hardware and the configuration of AADES.

2.6 File Management

The file management functions must ensure that the temporary files created as output of an AADES component are compatible with subsequent processing requirements and with the Input Geoname File for GNDB interface. The file management functions must not only be able to create, manipulate, and use as input the intermediate temporary files needed during Input Geoname File creation, but must also manage the accounting files. The outputs of AADES are a Input Geoname File, a written transaction report, and (if the data is not geographic names) an analyst file for the ASP (Automatic Symbol Placement) system. Thus, file management must handle not only the geonames data files but the accounting and system files.

2.7 User Front End

The physical system layout must provide the user with adequate space and facilities to handle large map sheets. A console must be easily accessible from

the map input station for the user to enter commands to initiate processing. The actual number of graphic workstations depends on the system constraints (such as budget, schedule, and space) and on the resulting management decisions. There will most likely be one command console per scanner, with several graphics workstation interfaces per scanner.

Both the scanner console and the graphics workstation must provide comfortable working environments. The system must supply a friendly user-machine interface. Careful software engineering and design is needed to ensure an efficient and easily-used system for the user. The main feature of the AADES user facility will be the ability of the user to override and interact with the system through the software, at any point during processing. The hardware and software must provide the option of extensive user interaction with the AADES.

2.8 Editing

The AADES editing functions must provide:

1. access and edit capabilities to all intermediate files created
2. automatic and/or interactive redundancy checks, and
3. both off-line and on-line edit options; that is, an unrecognized character will not halt the whole process, but will be stored for analyst action at a later time versus an unrecognized character interrupting the process until the analyst interactively identifies the character.

The specific edit software will depend on the hardware purchased. Many graphic workstations provide versatile editing functions which may make it unnecessary to have special software tailored for the AADES.

3.0 DATA STRUCTURES, DATA SETS, FILES

The following data structures and files described are not necessarily those that will exist in the final AADES. Depending on the scenario or on the amount and type of automation selected, these structures and files could vary. The purpose of this section is to depict the types of data structures and files that may exist in the AADES.

3.1 Input Material Assembly Data and Files

1. Inputs:

- 1) map sheet
- 2) separates
- 3) digital map data
- 4) accounting information

2. Outputs:

- 1) selected map or separate
- 2) formatted, on-line accounting file

3. Description

The map or separate serves as an "unformatted" data file. The accounting information, either entered interactively or captured from the legend, will be entered into a file for on-line storage. This will be a structured file of

specified fields with a comment field of flexible length.

3.2 Input Parameter Entry Data and Files

1. Inputs:

- 1) selected map or separate

2. Outputs:

- 1) selected map or separate
- 2) "legend" file

3. Description:

Depending on the degree of automation, the code tables and rules will already be in the system. The code tables will be extensive files containing data for reference or "look-up" information. Feature or generic tables, diacritic codes, and map symbols are a few of the data types that will be stored in files. These files must be formatted for easy access by appropriate processing functions.

Again depending on the degree of automation, rule bases will also be in the system prior to processing. The actual construction of these rules will be very time-consuming. Most rule bases are ASCII-readable files, often in LISP format. These files must be formatted for easy access by the inference engine. The more automated the final process configuration, the more files to be constructed and stored.

The "legend" file will contain information captured from the map legend.

This file will supply the data needed to trigger the appropriate rule base or to select the appropriate code table files.

3.3 Pre-Input Preparation Data and Files

1. Inputs:

- 1) selected map or separate

2. Outputs:

- 1) map or separate with or without pre-selected
 - names
 - position
 - attributes

3. Description:

This phase is highly dependent upon the degree of automation. In all three steps that preselect the names, feature positions, and attributes, the selection rules must be in the system. For interactive applications, these can be in a tabular form designed for quick access and easy reference. In an automated mode, the rule bases should be formatted for easy access by the inference engine. In the case of unsymbolized features and attributes, building these bases will be difficult.

3.4 Analog-To-Digital Data and Files

1. Inputs:

- 1) selected map with or without pre-selected:

- names
- positions
- attributes

2. Outputs:

- 1) preliminary geonames input file
(pre-proof/edit/correction version)
- 2) raster or vector digital map data

3. Description:

The files involved in this component of AADES will depend on whether a selective process is used only to capture the names and associated information or whether the whole map is captured initially. If one of the selective methods is used, such as typing at a keyboard, OCR wand, or scanning cursor, the files and data structures will be preliminary Input Geonames files. If the whole map or separate is converted to digital form, then the files and data structures will be raster and/or vector data files.

3.5 Names Recognition Data and Files

1. Inputs:

- 1) raster or vector map data
- 2) rule bases, font libraries (see Input Material Assembly)

2. Outputs:

- 1) raster or vector map data
- 2) temporary names file with:

- name
- approximate position
- generic (if any)
- font style/size
- orientation of name

3. Description:

The digital map data will be processed for names location, identification, and recognition. This requires the temporary creation of files and data structures during processing. Depending on the software design, the actual number and structure of these files will vary.

3.6 Names Capture/Recording Data and Files

1. Inputs:

- 1) temporary names file

2. Outputs:

- 1) temporary names files

3. Description:

The temporary names file created during the preceding Names Recognition stage will be stored in a temporary Input Geonames File with specified record and field structures. The digital map data, which is not processed during this stage, will be passed to the next stage for resumed processing.

3.7 Feature Association Data and Files

1. Inputs:

- 1) stored names with position and feature type (if known)
- 2) digital map data

2. Outputs:

- 1) file with names, position, and associated feature
- 2) digital map data

3. Description:

During this component of AADES, the name and corresponding feature are associated. The file and data structures must be compatible with the final Input Geonames File.

3.8 Position Capture/Recording Data and Files

1. Inputs:

- 1) names file with position and associated feature
- 2) digital map data

2. Outputs:

- 1) names file with final position to specified accuracy and associated feature
- 2) digital map data

3. Description:

Depending on the desired accuracy, position will be determined and stored. Again the data structures and file at this point are compatible with the final Input Geoname

3.9 Attribute Capture/Recording Data and Files

1. Inputs:

- 1) names file with final position to specified accuracy and associated feature
- 2) digital map data

2. Outputs:

- 1) a preliminary geonames file containing
 - names
 - position
 - associated features
 - attribute information

3. Description:

The data structures and file are, for all purposes, equivalent to the Input Geoname File. The file format will conform to GNDB requirements.

3.10 Proof/Edit/Correction Data and Files

1. Inputs:

- 1) Geoname File, pre-corrected version

2. Outputs:

- 2) final version Geoname File

3. Description:

This is the final preparation stage of the geonames input for GNDB. The data structures and file format are the same as the previous phase.

3.11 Input Geoname File Creation Data and Files

1. Inputs:

- 1) Geoname File

2. Outputs:

- 1) Input Geoname File
 - 2) transaction report
 - 3) non-geoname information report

3. Description:

The Input Geoname File, formatted according to GNDB requirements, exists at this point of the processing. At this stage, the file is checked before copying the file to the transfer device (such as disk or tape) for GNDB input. The accounting file or transaction report will be printed for analyst reference. This file was created at the beginning of the process flow and was updated throughout the process. Any pertinent non-geoname information will be in a file

for analyst printout if desired. The content, and therefore the structure, of this file will depend on user goals.

4.0 GNDB INTERFACE

The AADES-GNDB interface will be the Input Geonames File stored on magnetic tape or disk. This file is the AADES output and will serve as the GNDB input. The file format, records and field lengths will be according to GNDB specifications (see Appendix IV). The integrity of this file will meet specified accuracy requirements, which will have been enforced through AADES quality control.

5.0 ASSUMPTIONS AND CONSTRAINTS

In the course of conceptualizing the AADES, the following assumptions were made about the systems input and output, and about the Geographic Names Data Base (GNDB):

- o System

An optimal system does not exist. The proposed AADES will initially be a computer-assisted prototype with the eventual goal of full automation. This testbed system will be highly flexible with scanning, voice entry, and interactive edit capabilities. There will be tradeoffs with general digitizing technology and the machines may be shared with production digitizing, thus reducing costs. The comprehensive map projection programs that now exist will be reduced to microcircuit chips.

o Input

Source maps must be in series form, otherwise manual or interactive entry would be more effective. Plate separations of foreign maps probably will not be available. Initially, ideograms and characters with diacritics will be recognized, as will hand-printed characters in the future. Rules regarding source map type fonts, type placement, and symbolization will be available.

o Output

The GNDB will be utilized for map names selection, type generation, and placement.

o GNDB

The existence of the GNDB and prior entry of the gazetteers, gazetteer tapes, and Multiset III tapes is assumed. The resolution of discrepancies and merging of newly-entered and existing GNDB data will not be a function of AADES.

Constraints are limited to time and performance with resource limitations unknown. The system should be fully operational by 1989. Speed, error rate, and cost of operation should be substantially less than current systems.

6.0 SYSTEM SCENARIOS

The purpose of this section is to examine various solutions to both the AADES design and the input problem. While the ultimate goal of this study is a highly-automated names entry system, the enormity of the names requirement should also be addressed. By suggesting various employable scenarios and projecting throughput needs, one or more courses of action may be indicated.

6.1 Alternatives

Considering on existing systems and the functional analysis in preceding sections, makes it apparent that the AADES will be automated, with some interactive capability. The pure manual approach described in 1.1.1 and 1.2.1 is both dated and costly. The approaches to be examined, then, are either interactive, automated, or combination of the two. Each of the five scenarios will be discussed individually and then summarized in chart form. See Table 6-1.

6.1.1 Interactive

The method employed by the CIA and the Chicago Aerial Survey uses an interactive edit station to key in the name and attributes and to digitize the feature position. The USGS system is similar except that the digitizer lacks an interactive capability. This existing technology can readily be contracted and has the advantage of immediate availability. On the negative side, it is very labor-intensive, especially at the checking stage.

6.1.2 Interactive - Selective Names Capture

This scenario would utilize an interactive edit station in essentially the same manner as above, except for names capture. An OCR wand, scanning cursor, or voice entry would be used to record the name, which would then be displayed for verification. The savings in time and relative accuracy would have to be measured in a testbed environment. The advantage of faster entry may be significant in view of the overall task. The disadvantages are increased cost and a potentially higher error rate.

6.1.3 Automated-Interactive

In this combined approach, the source map is scanned, the resulting data is processed, and then editing and correction is done interactively. The processing stage recognizes the characters, locates the feature if possible, and converts the results to vector data and ASCII code. The scanning could be done only on the type and associated feature symbols, or it could be done on the entire unseparated map image. The type and point symbol mode would reduce processing time but would not provide reference data for editing. The reverse would be true for unseparated data. The scenario enjoys significant advantages in that the hardware exists, prototype systems are available, throughput potential is high, and the processing stage capabilities could be incremented to reduce human involvement. The only disadvantage would be the unproven capability of the system.

6.1.4 Automated-Interactive Plus Video

The system described in 6.1.3 is augmented by a video camera at the workstation and a display mixes the video image with the scanned characters. The result would be an enhanced edit and correction capability. The advantages and disadvantages would be the same as those in 6.1.3, with the exception of the

Improved editing.

5.1.5 Automated

A fully automated system presumes a satisfactory solution of all the character recognition, feature location, and attribute capture problems. The source map must be scanned and data processed perfectly. The decisions currently made by toponymists would presumably have been reduced to a knowledge-based system by the time a fully automated system is implemented. Given the variety and complexity of source maps worldwide, the development of a totally automated system will take a long time.

Table 6-1 SYSTEM SCENARIO SUMMARY

Name	Equipment	Estimated Costs Equipment	Costs Project*	Risk	Comments
Interactive	Digital graphics edit system	60K per station	25M	none	readily contracted
Interactive -Selective Names Capture	Digital graphics edit station plus OCR, wand scanning cursor, or voice entry	75k per station	23M	moderate	avoids key entry
Automated- Interactive	Scanner, Computer, Digital graphics edit system	Scan Systems Variable +100k up 60k per station	23M	slight	prototype systems available
Automated- Interactive Plus Video	Scanner, Computer, Digital graphics edit system, video	Scan Systems Variable -100k up 70k per station	22M	moderate	reduced editing
Automated	Scanner, Computer	Scan Systems Variable -500k	30M	high	n/a

6.2 Data Entry Throughput Projections

To forecast input requirements in terms of systems and staff, several assumptions were made. Subtracted from the eventual data base estimate of 60 million geonames were 5 million from the existing Foreign Place Names file and another 5 million from domestic and foreign sources. This left 50 million to be input by AADES. Subtracting weekends, holidays, and 5% system downtime gave 238 working days per year available for 3-shift operation. How many names must be throughput per working day to reach the 50-million-name goal by 10, 15, or 20 years? To reach goal in 10 years will require the entry of 21,000 names per working day. If 15 years is acceptable, 14,000 names are needed daily, and 20 years requires 10,500.

6.3 Scenario/Project Analysis

A very large number of names must be processed daily to reach goal even if that time were extended to 20 years. This does not include updating, which must be done in the interim and which may compete for the same resources. To maintain a work flow of this magnitude, the final version of AADES must be highly optimized and thoroughly tested.

Each of the five options has a time penalty either in development or throughput. Available systems are slower, but optimized ones will take time to assemble and test. Therefore, a combination of the scenarios might be desirable. Using available production entry systems for high-priority areas in conjunction with both development and research thrusts will minimize the risks and enable input to be maintained throughout.

7.0 HARDWARE REQUIREMENTS

The critical hardware elements of the AADES are the map scanner and the interactive graphics workstation. Existing commercial scanners are adequate in terms of positional accuracy and resolution (for example, 1000 lines per inch resolution, +/-25 microns absolute position accuracy). It is anticipated that large-format maps will need to be scanned; input materials up to 40"x40" are accepted by some scanners but the ability to handle larger sizes is rarer. Major improvements in scanning speed are anticipated in several new scanners due to be announced this year (e.g. XYZ Tech); price/performance breakthroughs also seem imminent. Therefore, by 1985 several vendors should be marketing large format, high speed, and moderately-priced scanners (under \$100,000) suitable for AADES.

To provide needed flexibility in processing a variety of input maps, the scanner must have a color-recognition capability. Depending on the particular type of map, from 4 to more than 20 colors may be used. Although text generally appears in only a limited range of colors (such as black, blue, brown, and purple), feature-symbolization recognition will require capturing the other color information on the map.

A very useful feature of the scanner is the ability to vary the resolution level under operator or software control. This capability can be used to avoid the digital entry of map line work and noise that are extraneous to the task of names data base development.

A hardware item sometimes associated with scanners is an array processor to handle the major computational tasks associated with processing the scanned

raster data. The most important example is the conversion of the raster data to a vector structure. This activity place a very heavy computational burden on a host system, slowing the AADES work flow if the host computer is used to simultaneously perform additional tasks. Some firms have developed proprietary "black boxes" to perform raster-to-vector conversion; these are usually built around an array processor (such Anatech). Other vendors have incorporated raster-to-vector software as part of a turnkey system (for example, Scitex and Intergraph). In these cases, the conversion is sometimes carried out on a special-purpose microprocessor(s).

The following table summarizes the key scanner hardware requirements:

1. input document size: at least 36"x48"
2. scanning resolution: variable, 100-1000 lines per inch
3. absolute accuracy: $\pm 1/-25$ microns
4. color detection: at least 12 colors
5. gray level detection (optional): 64 gray levels
6. input material: paper maps or film (printed, hand inked, or penciled)

To adequately support experimentation and the evaluation of manual, computer-aided, and automated approaches to AADES, the graphics workstation will include the following:

- o Digitizer table (manual digitization)
 - large format
 - medium precision/resolution
 - softcopy echo

- cursor with at least 12 programmable function keys
- o Color graphics CRT
 - 19-inch diagonal
 - medium resolution (512x512)
 - 12 colors simultaneously
 - user interface through touch, trackball, etc.
- o Optional peripherals
 - OCR wand
 - scanning cursor
 - voice data entry
 - video imaging system

8.0 SOFTWARE REQUIREMENTS

The functional (applications) software requirements for AADES are parallel to the AADES functions as described in this report. The critical software components are:

- o character recognition
- o word recognition
- o name recognition
- o feature association
- o position determination
- o attribute determination
- o projection conversion

Software to carry out these functions in an automated mode is currently in various stages in the development cycle. AADES will include as much existing automated capabilities as practical while, simultaneously, having the hardware/software resources to support interactive approaches to carrying out the above-listed functions.

8.1 Character Recognition

AADES will have the ability to identify and isolate, through automated techniques, all characters, ideograms, and diacritics on a map. This capability should allow for arbitrary font orientation. Based on available font libraries and on generic-character recognition algorithms, AADES will recognize the identified characters as much as possible through automated techniques. Unrecognized characters (or characters recognized but not with the required confidence level) will be brought to the operator's attention for key or voice entry. AADES software will have the capability to unambiguously represent and record all possible characters, ideograms, and diacritical marks. In addition, these items will be realistically displayable on the operator workstation(s). For each identified character, the type font and orientation may be obtained and recorded.

8.2 Word Recognition

AADES software will provide the capability to aggregate characters, ideograms, and diacritics into word units. This will be accomplished by examining of character orientation, inter-character spacing, use of hyphenation, and language-specific rules for word formation. Interactive aids and procedures will be used to settle ambiguous situations of word identification.

8.3 Name/Text Recognition and Understanding

In this functional area, words belonging to a single geographic name are identified. Non-geographic name text will be recognized and either discarded or used for map parameter input (such as legend information). It is important to note that much of the text on maps is not proper geographic names but instead consists of legend information, scale, map titles, authorship, and unnamed features (spring, ranch). For names that include both a specific and a generic component, the two constituents will be recognized as such and handled differently. Understanding the generic portion of the name, when available, may be useful in assigning an accurate feature classification to the name and may also assist in attribute tagging. For example, the importance of inland hydrographic features (lakes, ponds, roads, creeks, or brooks) may be implied by a generic term present on the map. Rules for deriving this kind of information from features must be language-specific and must be used in combination with other evidence of importance (such as the size of the feature, or the size of the font). Appendix III presents a list of generic terms sometimes found on maps and their associated feature classes.

In an interactive mode, this task may be carried out by operator interaction with a display depicting recognized words within an appropriate map background. The operator can quickly indicate those words that are names (or are not names) and, for each name, the generic and specific components (where applicable). This would remove the need for automated names understanding software.

8.4 Feature Association

Software will be required to identify the feature (in the digital map data) that a recognized name refers to. Automated techniques will detect the most likely feature associated with a given name based on appropriate feature symbol, proximity, use of leader lines, and other criteria. Automation of this task will require symbol recognition software (point, line, and area symbols). It also will require the availability of rules relating type fonts and color to feature types. Additional intelligence would also be useful in this task: for example, rules dealing with the placement of names around or in feature symbols (and vice versa), or the effect of surrounding features on finding the feature associated with the given name.

In the interactive mode, computer-assistance software could generate a feature association display that would flash the name for which a feature is to be found. The operator would then point to the associated feature displayed on the terminal. The system will have the ability to recognize the feature indicated by the operator and to flash the specified feature on the display, as well as to provide feature descriptor information to the operator. If the operator detects a problem in selecting or interpreting the correct associated feature, he or she will have the opportunity to correctly describe the feature to the system. In the instances in which no explicit feature representation exists, the operator will indicate this before beginning feature search. Based on the type of name under consideration (that is the kind of feature referred to), it may be possible, for a specific map series, to identify those names which will not have explicit features on the map (such as named mountain ranges).

8.5 Position Capture and Recording

AADES software will include the determination of appropriate positional information for named features, based on rules dependent on feature type and symbolization. The software will include calculation of median (or mean) centers of point symbols; start, end, and boundary intersection points of linear features; and centroids and generalized boundary points for area features.

Once the features associated with a specific name have been identified, the required positional information is usually relatively easy to obtain. In some instances, however, ambiguities may exist. A case in point involves network-type linear features (that is roads, rivers, and railroads) for which it is difficult to determine start and stop locations for a specified name. The use of alternative names for the same linear feature based on language or political differences may also create difficulties in start and stop position assignment. In these cases and others, the operator will have the ability to digitize (using screen or digitizer cursor) the positions needed for a particular named feature. In addition, to assist in quality control, the software will echo the determined (or supplied) positions by placing a special symbol at those points with the appropriate map background.

8.6 Attribute Capture and Recording

AADES software will permit capturing the key feature attributes available on the input maps and relevant to map names placement and toponymic research. Much of this information will have been captured during previous steps in AADES processing (especially in names capture and feature association). On some maps and for some entire map series, this attribute information may not be

represented on the map or may be very difficult to recognize in an unambiguous way. For these reasons, an interactive capability will be provided to permit attribute tagging based on previously-unrecognized map information or on outside (non-map) sources of information.

8.7 Proof/Edit/Correction

Each of the functional software areas described above will include automated checks to indicate major problems in names recognition, feature association, position assignment, and other functions. Rules will be defined to indicate names, positions, feature classes, and attributes that are clearly in error. These conditions will be communicated to the operator by providing as much information as possible on the context of the potential situation (for example, by using graphics). The operator will then insert corrections into the names file or flag the specific problem name for future attention.

Following completion of basic names data capture for an entire map, a proof plot consisting of names and feature symbols placed at the indicated positions will be produced. In addition, a listing of the names file will be output. This listing will include flags to notify the user of problem records, missing fields, and other problems. Based on the proof plot and listing, the operator will be able to edit any field of any name record using the display and the digitizer as necessary.

8.8 Input Geoname File Creation

Formatting and tape or disk file generation software will allow AADES to provide properly structured input geoname files to the GNDB subsystem.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The selection of a particular technical approach to accomplish the task of capturing geonames information depends, to a large extent, on the non-technical factors that affect requirements for the DMA Geonames Data Base. A very inexpensive approach to names data capture is simply to make use of names files developed during ongoing product generation. This approach creates a minimal demand for additional hardware, software, and human resources. However, the "Build as you go" approach will also pay back very few dividends in terms of a usable names data in the short term (within 10 years) or even in the medium term (within 25 years). The rate of capture will be slow and the names entered into the data base will be for the map products which were generated most recently which, therefore are less likely to be used in the near future. This approach ignores the potential of having items in the data base that are not currently used in DMA map products.

As described in Section 1 of this report, each of the agencies that are or have been involved in building a names data base has opted for a bulk, one-time data capture approach to provide a baseline geonames file. For bulk data capture from maps, which are the primary sources of geonames information, a wide variety of technical approaches are possible. The major alternatives, as described in Section 7 of this report, range from a primarily manual approach, through computer-assisted interactive approaches, to an approach that maximizes automation.

The selection of a particular must consider the following factors:

- o Cost of hardware, software, and labor

- o Time needed to complete data capture
- o Risk involved in developing new capabilities
- o Management approach, such as contracting for services,
as opposed to in-house production
- o Input source characteristics such as map series instead of
one-of-a-kind maps, or whether text is non-romanized
- o Priorities: for example, comprehensive coverage of small regions
as opposed to less comprehensive world-wide coverage

To select one of the methods with a reasonable degree of confidence, a more detailed trade-off analysis must be performed. This analysis requires as input basic information from DMA concerning priorities, input sources, and management approaches. The results of a preliminary analysis of selected major technical alternatives for AADES were presented in Table 6-1.

Based on this limited analysis, some kind of interactive approach to AADES seems preferable to either the highly manual or the highly automated approaches. The manual approach will require either a very long time and/or a large number of people to complete basic data capture. The highly automated alternative is technically risky, will provide an unknown degree of cost/time saving, and is dependent on the use of large map series (such as the DMA JOG-G) for input to ensure cost-effective automation.

Within the general interactive category, a distinction can be made between a true softcopy (digital) system and a hardcopy-oriented system. The actual capture of the geoname itself can be accomplished using:

- o key entry

- o voice entry
- o selective scanning (wand, scanning cursor)
- o map scanning

The first three approaches are basically substitutes for one another. Key entry requires no machine recognition, in contrast to voice entry or scanning. With appropriate personnel and procedures, key entry can be both relatively fast (if there is adequate pre-input document preparation) and accurate. The relative benefits of voice entry or selective scanning as compared to key entry are unknown and require further study and experimentation in a realistic AADES environment.

Scanning an entire map (or gazetteer page) eliminates the need for locating and capturing individual names. However, the system must then be able to identify geonames; this can be accomplished either interactively or automatically. In an interactive mode, an operator working at a graphics workstation could point to a start (and end) of a geoname; this portion of the digital data base would then be input to an automated character-recognition module. If the scanned map was a names (or text) separate or overlay, the process of automatically locating characters within the digital file would be simplified. Some scanners can, of course, accomplish the separation (by color) internally, thus reducing the need for using separates as input documents.

In a typical softcopy AADES approach, an entire map (non-separated) would be scanned by a color scanner. Text information would be isolated using color size and shape characteristics as criteria. Automated character recognition would be used as much as possible. Characters or line segments that are potentially characters that have not been interpreted by the OCR software will

be displayed to the operator in map context. The operator may then use key or voice entry to define the character(s).

In this method, positional and feature class/attribute information could be captured either by interactive, computer-assisted means or by automated procedures. One possible solution would be to automate as much as possible, using existing or low-risk to-be-developed software and to use computer-assisted tools to facilitate interactive entry where automation is not feasible. For example, based on software developed in DMA's Auto Carto Feature Identification project, it is possible to automatically identify commonly-used map symbols found on standard DMA map products. Therefore, using these maps as input, AADES could automatically detect approximately 50% of geoname -- associated feature pairs needed for automatic positional information capture. Names without detected associated features (or with ambiguous results in feature association) would be displayed on the screen together with map feature information. The operator would then identify the associated feature by pointing to it. The system could then accurately determine the feature's position(s).

This approach, involving map scanning and interactive and automatic processing, offers a great deal of flexibility and growth potential. It also involves very little technical risk since all of the required functioning can be carried out in the interactive mode. The cost of additional hardware (the scanner) is greater than in other alternatives, but is rapidly declining. For example, one firm (XYZTEK) has recently announced a large-format, high-speed scanner for under \$60,000, and suitable microprocessor-based graphics workstations are now available for \$10-30,000. One scanner could supply several distributed workstations (from 4 to 12) with adequate data input resources.

Figure 9-1 presents a possible configuration for AADES. By supplying some (or all) workstations with alternate data entry devices (such as voice entry, wand, and scanning cursor), tests could be carried out to evaluate their respective strengths and weaknesses. Thus, this configuration would satisfy the requirements for a testbed AADES and for a developmental version of an operational system. It can be assembled using existing technology. Software development could be carried out, if deemed appropriate, to improve automation and to develop computer assistance aids to improve system efficiency.

In our view, in order to determine whether or not there is a requirement for AADES and, if so, what the nature of that requirement is, a more detailed and quantified requirements analysis and system design must be undertaken. The present study provides a foundation for this subsequent analysis by describing current technologies and by providing a functional description of the geonames capture process. A more detailed requirements analysis and system design would develop quantitative assessments of the cost and time factors associated with the technology alternatives. This will support an in-depth, formal trade-off analysis to evaluate the various approaches.

To be most useful, such an analysis requires detailed information on the number and characteristics of the input map sources. Study of typical map sources could generate very useful data on geoname frequency, font, feature symbolization, geoname orientation, feature classification, and other characteristics. The adoption of a priority scheme for data input by DMA will allow for better analysis of input data parameters and, therefore, a more detailed statement of AADES requirements and a more accurate trade-off analysis.

By breaking down the major functional elements of AADES to finer detail,

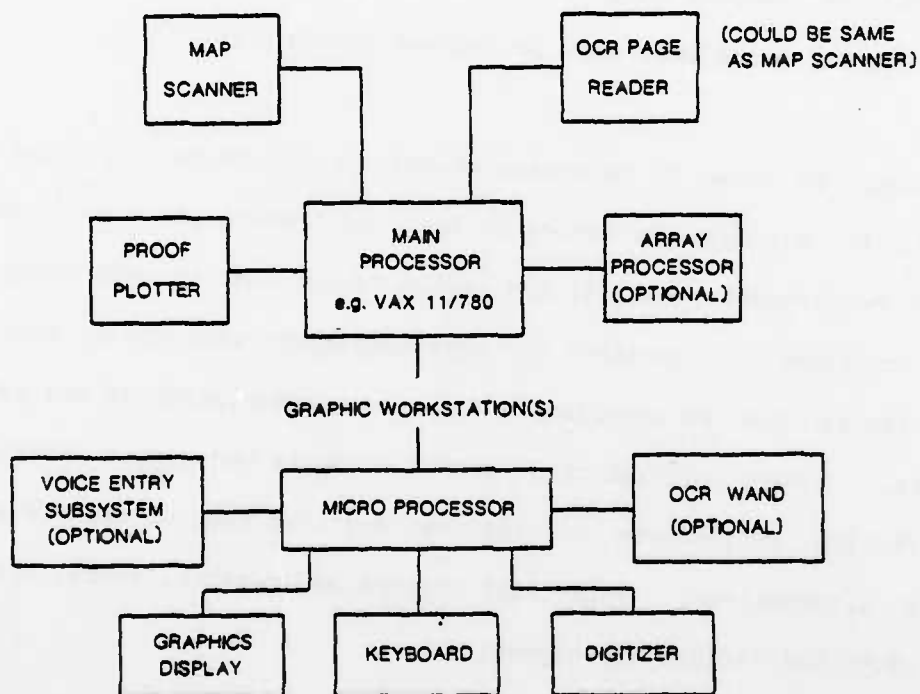


FIGURE 9-1
PROPOSED AADES CONFIGURATION

more accurate time, cost, and personnel requirements can be developed. For interactive processes, it is necessary to examine required keystrokes, hand movement, map feature searches, and other specific activities of the operator to get a good estimate of the time it takes to carry out the process. We recommend that a detailed trade-off analysis be performed, based on an evaluation of the source material to be used as AADES input. At the conclusion of this analysis, accurate quantitative comparisons between the alternatives will be possible.

APPENDICIES

1. Appendix I: DMA JOG Sheet Font Examples
2. Appendix II: DMA JOG Sheet Point Symbol Examples
3. Appendix III: Feature Categories of GNIS (U.S. Geological Survey system) Sorted by Generic
4. Appendix IV: Planning Systems Incorporated Preliminary AADES-GNDB Interface Requirements
5. Appendix V: Equipment Manufacturers of Voice I/O Equipment
6. Appendix VI: OCR and Scanner Market Briefing Notes
7. Appendix VII: AADES Reference List

AD-A142 518

REPORT ON FUNCTIONAL DESIGN SPECIFICATION FOR THE
AUTOMATED ALPHANUMERIC..(U) PAR TECHNOLOGY CORP NEW
HARTFORD NY A L DOWNS ET AL. 30 JAN 84 PAR-84-13

2/2

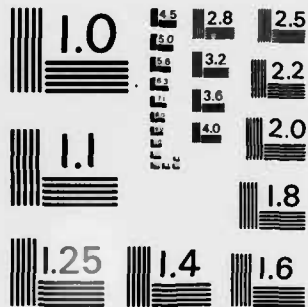
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NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

APPENDIX I

RECOGNIZABLE EQUIVALENTS FOR THE TYPE STYLES
AND SIZES SPECIFIED MAY BE SUBSTITUTED PROVIDED
THEY MEET WITH THE APPROVAL OF NATIONAL AUTHOR-
ITIES.

	PLACE NAMES: DEVELOPED AREAS*	Example	Specifications
107	First importance	LONDON	12 PT UNIFORMS BOLD CONDENSED CAPS
108	Second importance	RIGA	10 PT UNIFORMS BOLD CONDENSED CAPS
109	Third importance	Hopbarn	10 PT UNIFORMS BOLD CONDENSED CAP
110	Fourth importance	Finley	10 PT UNIFORMS MEDIUM CONDENSED CAP
111	Fifth importance	Nadun	8 PT UNIFORMS MEDIUM CONDENSED CAP

*Where feasible, populated places will be classified according to available population data.
Alternate names shall appear in parentheses below or following the primary name in the
same style type, but using the next smaller size.

**Names for populated places of fifth importance shall be omitted from Series 1501 A1R
unless otherwise specified in supplementary project instructions.

	POLITICAL DIVISIONS ¹ AND RESERVATIONS	Example	Specifications
112	Country name along boundaries	----- CANADA UNITED STATES -----	8 PT UNIFORM BOLD CONDENSED CAPS
113	Interterritorial or first-order administrative names along boundaries	----- UZBEK SSR KIRGIZ SSR -----	8 PT UNIFORM BOLD CONDENSED CAPS
114	National or state parks, forests, reservations, etc.	NATIONAL FOREST NATIONAL FOREST NATIONAL FOREST NATIONAL FOREST	8-10 PT UNIFORM MEDIUM CONDENSED CAPS DEPENDING UPON SIZE OF AREA

BUILDINGS, LANDMARKS, PUBLIC WORKS, NOTES

115	Abandoned canals, aerial cableways, airfields, aqueducts, bridges, canseways, conveyor belts, dams, ferries, fords, forts, landmark buildings, located or landmark objects, mines, mining areas, mosques, monasteries, pipelines, ruins, submerged breakwaters, locks, telephone telegraph lines, tunnels, underground aqueducts, underground pipelines, wells, wells (oil, gas, salt, etc.) and similar features	No to necessary	8 PT UNIFORM MEDIUM CONDENSED CAPS
116	Railroads, roads, trails	----- PENNSYLVANIA -----	8 PT UNIFORM MEDIUM CONDENSED MATH CAPS
117	Notes covering large areas	NUMEROUS SINK HOLES NUMEROUS SINK HOLES NUMEROUS SINK HOLES	8-12 PT UNIFORM MEDIUM CONDENSED CAPS DEPENDING UPON SIZE OF AREA
118	Notes covering small areas, or for spot features	Abandoned	8 PT UNIFORM MEDIUM CONDENSED CAPS

¹ Type pertaining to features appearing on drainage drawing will print blue.

² When used fully enclosed within one primary division, letter space name across center of land area, in 80-10 pt. Uniform Bold Condensed Caps.

³ Descriptive type in parenthesis (conveying proper name) will always be shown in lower case type.

* BLUE IN COLOR

	FORESHORE AND OFFSHORE FEATURES	Example	Specifications
119	Reefs, rocky ledges	Coast reef	6 PT UNIFORM MEDIUM CONDENSED CM

DRAINAGE FEATURES*

120	Large bodies of open water	ATLANTIC O ATLANTIC O LAKE ERIE LAKE ERIE	14 30 PT. CLEARANCE HALL CAPS (EXTENDING)
121	Medium size bodies of open water	LAKE ERIE LAKE ERIE LAKE ERIE	10 14 PT. CLEARANCE HALL CAPS. (EXTENDING IF SPACE PERMITS)
122	Small bodies of open water	KITTY HAWK BAY KITTY HAWK BAY KITTY HAWK BAY	6 6 PT. CLEARANCE HALL CAPS. (EXTENDING IF SPACE PERMITS)
123	Smaller bodies of open water, ponds, lakes, inlets, small bays, etc.	<i>Tulch Lake</i> <i>Tulch Lake</i>	6 6 PT. CLEARANCE HALL CM

*Alternate names shall appear in parentheses below or following the primary name in the same style type, but using the next smaller size. On sheets of sparse detail, where a choice of size of type is allowed for an item, preference shall be given to a larger size.
 18 pt. in congested areas.

* BLUE IN COLOR

	DRAINAGE FEATURES* (CONTINUED)	Example	Specifications
124	Large rivers	<i>HUDSON RIVER</i> <i>HUDSON RIVER</i>	10 12 PT. CLEARANCE ITALIC CAPS, EXTEND IF FEATURE IS LONG **
125	Medium width rivers	<i>HUDSON RIVER</i>	10 PT. CLEARANCE ITALIC CAPS, EXTEND IF FEATURE IS LONG **
126	Narrow double line streams	<i>BLUE RIVER</i> <i>BLUE RIVER</i>	80 PT. CLEARANCE ITALIC CAPS **
127	Large single line streams	<i>Blue River</i>	40 PT. CLEARANCE ITALIC CAP
128	Medium size single line streams	<i>Blue River</i> <i>Blue River</i>	30 PT. CLEARANCE ITALIC CAP
129	Small single line streams	<i>Blue River</i> <i>Blue River</i>	20 PT. CLEARANCE ITALIC CAP
130	Large swamps and similar features	<i>DISMAL SWAMP</i> <i>DISMAL SWAMP</i> <i>DISMAL SWAMP</i>	10 10 PT. CLEARANCE ITALIC CAPS, EXTEND IF SPACE PERMITS
131	Medium size swamps and similar features	<i>DISMAL SWAMP</i> <i>DISMAL SWAMP</i>	8 10 PT. CLEARANCE ITALIC CAPS, EXTEND IF FEATURE IS LONG
132	Small swamps and similar features	<i>Blue Swamp</i> <i>Blue Swamp</i>	60 PT. CLEARANCE ITALIC CAP
133	Aqueducts, canals, cranberry bogs, falls, peat bogs, rapids, springs, water holes, and similar features and notes	<i>Cranberry bog</i> <i>Rapids</i>	6 PT. BOLDING MEDIUM CONDENSED CAP

* Alternate names shall appear in parentheses below or following the primary name in the same style type, but using the next smaller size. On sheets of sparse density, where a choice of size of type is allowed for an item, preference shall be given to the larger size.

** Proper names for these features shall be shown in 8 pt. Clearance Italic CAP.

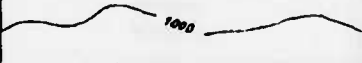
** Type sizes for double line streams will not be graduated when the stream, extending across the sheet, maintains a fairly constant width.

	RELIEF FEATURES*	Example	Specifications
131	Large regional features	<i>DIRONDAC</i> <i>A DIRONDACK</i> <i>ADIRONDACK</i>	14.28 PT UNIFORM MEDIUM CONDENSED NAME CAPS
134	Large single features, approximately 5 to 8 inches	<i>ADIRONDACK</i> <i>ADIRONDACK</i>	12.14 PT UNIFORM MEDIUM CONDENSED NAME CAPS
136	Features 1.5 to 5 inches long	<i>ADIRONDACK</i> <i>ADIRONDACK</i> <i>ADIRONDACK</i>	8.12 PT UNIFORM MEDIUM CONDENSED NAME CAPS
137	Features less than 1.5 inches	<i>ADIRONDACK</i> <i>ADIRONDACK</i>	6.6 PT UNIFORM MEDIUM CONDENSED NAME CAPS
138	Peaks, tops, knobs and similar features	<i>PIES PEAK</i> <i>PIES PEAK</i>	6.6 PT UNIFORM MEDIUM CONDENSED NAME CAPS
139	Claps, hollows, shoals, river beds, glaciers, small ponds, small islands, passes and similar features	<i>Bald Point</i> <i>Bald Point</i>	6.6 PT UNIFORM MEDIUM CONDENSED NAME CAPS
140	Area identifications, large	<i>LAVA</i> <i>LAVA</i>	10.12 PT UNIFORM MEDIUM CONDENSED CAPS

*Alternate names shall appear in parentheses below or following the primary name in the same style type, but using the next smaller size. The sheets of sparse detail, where a choice of size of type is allowed for an Area, preference shall be given to a larger size.

†Label glaciers on Drainage copy for printing in blue.

**The names for minor relief features shall be omitted from Series 1501 ATR unless they are of air navigational value.

	RELIEF FEATURES (CONTINUED)	Example	Specifications
141	Area identifications, medium size	KARST BABS?	8 D PI UNIFORM MEDIUM CONDENSED ITALIC
142	Area identifications, small	Isle	8 PI UNIFORM MEDIUM CONDENSED ITALIC
143	Asphalt lakes, boulders, caves, islands (not named), etc.	Boulder	8 PI UNIFORM MEDIUM CONDENSED ITALIC
144	Contour values	 1000	8 PI UNIFORM MEDIUM CONDENSED ITALIC
145	Spot elevations, normal	792	8 PI UNIFORM BOLD CONDENSED
146	Spot elevations, highest in general area	1273	10 PI UNIFORM BOLD CONDENSED
147	Spot elevation, highest on sheet	1820	12 PI UNIFORM BOLD CONDENSED
148	Tundra	TUNDRA	6 12 PI UNIFORM MEDIUM CONDENSED ITALIC

149	Area name	ALASKA	8 12 PI UNIFORM LIGHT CONDENSED CAPS
-----	-----------	--------	--------------------------------------

TYPE STYLES AND SIZES

ITEM
TYPE STYLE AND SIZE

SAMPLE

DMAAC **
CASE
NO.

1ST CLASS CITIES BGN - 12 Pt. Caslon Bold Cond. Caps Conventional - 10 Pt. Lightline Gothic C & I.c.		WIEN (Vienna)	228 34
2ND CLASS CITIES BGN - 10 Pt. Caslon Bold Cond. Caps Conventional - 8 Pt. Lightline Gothic C & I.c.		WIEN (Vienna)	227 33
3RD CLASS CITIES BGN - 8 Pt. Caslon Bold Cond. Caps Conventional - 7 Pt. Lightline Gothic C & I.c.		WIEN (Vienna)	225 32
4TH CLASS TOWNS BGN - 7 Pt. News Gothic Caps Conventional - 5 Pt. Lightline Gothic C & I.c.		WIEN (Vienna)	4 30
5TH CLASS VILLAGES BGN - 7 Pt. News Gothic Cond. C & I.c. Conventional - 5 Pt. Lightline Gothic C & I.c.		Wien (Vienna)	18 30
POWER TRANSMISSION LINES RSPL NO. Spt. Century Schoolbook NO. OF LINES Spt. Lightline Gothic		2 (3) (3)	187 30
BOUNDARY NAMES 6 Pt. Caslon Bold Cond. Caps		GAMBIA	223
BOUNDARY LABELS 6 Pt. Caslon Bold Cond. Caps		US RUSSIAN CONVENTION OF 1867 APPROXIMATE ALIGNMENT	223
DATE LINE 8 Pt. Caslon Openface Caps and c & I.c.		DATE LINE (Sunday)	235
SOVEREIGNTY DESIGNATION Along boundaries 6 Pt. Caslon Bold Cond. Caps		(UNITED KINGDOM)	223
ISLAND SOVEREIGNTY 5 Pt. to 24 Pt. Lightline Gothic Caps		(FRANCE)	30 thru 38
DEMILITARIZED ZONE LABELS 7 Pt. Futura Medium Caps		DEMILITARIZED ZONE	289
MISSILE SITES 7 Pt. News Gothic Cond. Caps		ICBM IRBM SAM SA-1 SA-2	18
MOUNTAIN PEAKS 6 Pt. and 7 Pt. Formal Gothic Light Condensed		MT. SHASTA	85 and 86
MOUNTAIN RANGES, RIDGES AND DESERTS (spaced proportionately) 8 Pt. thru 18 Pt. Formal Gothic Light Condensed		JURA MOUNTAINS	87 thru 92
RESERVATIONS 7 Pt. thru 10 Pt. News Gothic Caps (spaced proportionately)		MILITARY RESERVATION	4 thru 7

** DMA case numbers refer to example occurrences of the item. See last two pages of this Appendix for an example (case numbers precede arrows).

•BLUE IN COLOR

MISCELLANEOUS INFORMATION NOTES <i>Radar significant use water lane</i> 5 Pt. Lightline Gothic C. & I.c. or I.c.		<i>School</i> <i>Shelter cost</i> Limit of wooded area information	30
SMALL ISLANDS, GROUPS & PENINSULAS 5 Pt. Lightline Gothic Caps or C. & I.c. or 7 Pt. and 8 Pt. News Gothic Cond. Caps or C.&I.c. <i>(spaced proportionately)</i>		<i>Silhouette island</i> SILHOUETTE ISLAND	30 18 and 19
LARGE ISLANDS, GROUPS, & PENINSULAS 7 Pt. thru 24 Pt. News Gothic Caps or C. & I.c. <i>(spaced proportionately)</i>		SILHOUETTE ISLAND	4 thru 12
POINTS AND CAPES 5 Pt. Lightline Gothic C. & I.c.		<i>Mystic Cape</i>	30
MISCELLANEOUS CULTURAL FEATURES 5 Pt. Lightline Gothic I.c. 5 Pt. Lightline Gothic C.&I.c. UNUSUAL LAND AREAS 5 Pt. Lightline Gothic I.c. 7 Pt. and 8 Pt. News Gothic Cond. I.c. <i>(spaced proportionately)</i>		<i>Fishing stands</i> <i>dismantled</i> <i>columns</i> <i>GEs</i> <i>TWR</i> <i>(3)</i> <i>harst</i> <i>dark area</i>	30 30 30 18 and 19
AIRFIELD NAMES 8 Pt. News Gothic Caps AIRFIELD DESCRIPTIVE NOTES 7 Pt. Lightline Gothic I.c. AIRFIELD ELEVATIONS 7 Pt. News Gothic Caps		BAKER AIRFIELD <i>abandoned</i> APPROX ELEV 500	5 32 4
CONTOUR VALUES 5 Pt. Cap. Gothic Italic Caps HIGHEST ELEVATIONS 10 Pt. Cap. Gothic Italic SPOT AND LAKE ELEVATIONS 6 Pt. Cap. Gothic Italic VERTICAL OBSTRUCTIONS 5 Pt. Lightline Gothic I.c.		250 <i>SEA LEVEL</i> 1255 430 430° 4 towers (1501)	123 127 124 30
ISOGONIC VALUES 12 Pt. Future Mod. Oblique Caps.		8°30'W	307
HYDROGRAPHIC NAMES AND LABELS DOUBLE LINE STREAMS 7 Pt. thru 14 Pt. Clearface Italic Caps <i>(spaced proportionately)</i> SINGLE LINE STREAMS 7 Pt. Clearface Italic C.&I.c. OCEANS, SEAS, GULFS, BAYS, ETC. 7 Pt. thru 24 Pt. Clearface Italic Caps LAKES, SALT WASTES ETC. 7 Pt. to 24 Pt. Clearface Italic Caps or C.&I.c. <i>(spaced proportionately)</i> DESCRIPTIVE NOTES 7 Pt. Clearface Italic C.&I.c. or I.c. CANALS 5 Pt. Cap. Gothic Italic Caps ICE PORTRAYAL 7 Pt. Clearface Italic C.&I.c.		<i>MISSISSIPPI</i> ° <i>tax Vases</i> ° <i>PACIFIC</i> ° <i>BONNEVILLE SALT FLATS</i> ° <i>salt pans</i> ° <i>coral</i> <i>RIEL CANAL</i> ° <i>Limits of Shell Ice</i> °	212 thru 217 212 212 220 212 thru 220 212 212 212

DMAAC CASE NO.	ALTERNATE NAME OR GENERIC TRANSLATION	
	GENERIC TERM AND/OR PROPER NAMES	TRANSLATION AND/OR ALTERNATE NAMES
170	5 Pt. Century Expanded Italic	5 Pt. Century Expanded Italic I.c. 170
212	7 Pt. Clearface Italic	6 Pt. Clearface Italic I.c. 211
213	8 Pt. Clearface Italic	7 Pt. Clearface Italic I.c. 212
214	9 Pt. Clearface Italic	8 Pt. Clearface Italic I.c. 213
215	10 Pt. Clearface Italic	9 Pt. Clearface Italic I.c. 214
216	12 Pt. Clearface Italic	10 Pt. Clearface Italic I.c. 215
217	14 Pt. Clearface Italic	12 Pt. Clearface Italic I.c. 216
218	16 Pt. Clearface Italic	14 Pt. Clearface Italic I.c. 217
219	18 Pt. Clearface Italic	16 Pt. Clearface Italic I.c. 218
220	24 Pt. Clearface Italic	18 Pt. Clearface Italic I.c. 219
34	5 Pt. Formal Gothic Light Condensed	5 Pt. Lightline Gothic I.c. 30
85	6 Pt. Formal Gothic Light Condensed	5 Pt. Lightline Gothic I.c. 30
87	8 Pt. Formal Gothic Light Condensed	6 Pt. Lightline Gothic I.c. 31
88	10 Pt. Formal Gothic Light Condensed	8 Pt. Lightline Gothic I.c. 33
89	12 Pt. Formal Gothic Light Condensed	10 Pt. Lightline Gothic I.c. 34
90	14 Pt. Formal Gothic Light Condensed	10 Pt. Lightline Gothic I.c. 34
91	16 Pt. Formal Gothic Light Condensed	12 Pt. Lightline Gothic I.c. 35
92	18 Pt. Formal Gothic Light Condensed	12 Pt. Lightline Gothic I.c. 35
123	5 Pt. Cap. Gothic Italic	5 Pt. Lightline Gothic I.c. 30
3	6 Pt. News Gothic	5 Pt. Lightline Gothic I.c. 30
4	7 Pt. News Gothic	6 Pt. News Gothic I.c. 3
5	8 Pt. News Gothic	7 Pt. News Gothic I.c. 4
6	9 Pt. News Gothic	8 Pt. News Gothic I.c. 5
7	10 Pt. News Gothic	9 Pt. News Gothic I.c. 6
8	12 Pt. News Gothic	10 Pt. News Gothic I.c. 7
9	14 Pt. News Gothic	12 Pt. News Gothic I.c. 8
10	16 Pt. News Gothic	14 Pt. News Gothic I.c. 9
11	18 Pt. News Gothic	16 Pt. News Gothic I.c. 10
12	24 Pt. News Gothic	18 Pt. News Gothic I.c. 11
17	6 Pt. News Gothic Cond.	5 Pt. News Gothic Cond. I.c. 16
19	8 Pt. News Gothic Cond.	7 Pt. News Gothic Cond. I.c. 18

COMPARABLE TYPE FACES

Type No.	DMA TC Comparable Type Face and Size	DMAAC DMAHC Comparable Type Face and Size	DMAAC Case No.	DMA TC Case No.
1	6 pt. News Gothic	6 pt. News Gothic	1	6-2041
2	12 pt. News Gothic	12 pt. News Gothic	2	10-2041
3	6 pt. News Gothic Condensed	6 pt. News Gothic Condensed	3	6-2041
4	8 pt. News Gothic Condensed	8 pt. News Gothic Condensed	7	6-2041
5	7 pt. News Gothic Condensed	7 pt. News Gothic Condensed	18	7-2041
6	8 pt. News Gothic Condensed	8 pt. News Gothic Condensed	19	8-2041
7	10 pt. News Gothic Condensed	10 pt. News Gothic Condensed	21	10-2041
8	6 pt. No. 3 Lightline	6 pt. Lightline Gothic	30	6-3-4521
9	6 pt. No. 4 Lightline	6 pt. Lightline Gothic	31	6-3-4521
10	6 pt. No. 4 Lightline	7 pt. Lightline Gothic	32	6-3-4521
11	8 pt. Lightline	8 pt. Lightline Gothic	33	8-4521
12	12 pt. Lightline	12 pt. Lightline Gothic	35	12-4521
13	14 pt. Lightline	14 pt. Lightline Gothic	36	14-4521
14		10 pt. Gothic 545	52	
15		7 pt. Light Copperslate Gothic Condensed	86	
16	12 pt. No. 26 Heavy Copper Gothic	12 pt. Heavy Copperslate Gothic	102	12-26-3421
17		10 pt. Heavy Copperslate Gothic Condensed	114	
18	12 pt. No. 17 Heavy Copper Gothic Condensed	14 pt. Heavy Copperslate Gothic Condensed	116	12-3431-17
19	18 pt. No. 29 Heavy Copper Gothic Condensed	18 pt. Heavy Copperslate Gothic Condensed	118	18-29-3421
20	6 pt. No. 51 Copper Gothic Italic	4 pt. Copperslate Gothic Italic	122	6-51-346K
21	6 pt. No. 51 Copper Gothic Italic	5 pt. Copperslate Gothic Italic	123	6-51-346K
22	6 pt. No. 54 Copper Gothic Italic	8 pt. Copperslate Gothic Italic	126	6-54-346K
23	12 pt. No. 55 Copper Gothic Italic	10 pt. Copperslate Gothic Italic	127	12-55-346K
24	12 pt. No. 56 Copper Gothic Italic	12 pt. Copperslate Gothic Italic	128	12-56-346K
25		8 pt. Century Schoolbook	187	
26	24 pt. Century Schoolbook	24 pt. Century Schoolbook	194	24-420A
27	6 pt. Sparten Light	6 pt. Futura Book	260	6-6061
28	6 pt. Sparten Light	7 pt. Futura Book	261	6-6061
29	8 pt. Sparten Light	8 pt. Futura Book	262	8-6061
30	10 pt. Sparten Light	9 pt. Futura Book	263	10-6061
31	12 pt. Sparten Light	14 pt. Futura Book	266	12-6061
32	6 pt. Sparten Light Italic	6 pt. Futura Book Oblique	274	6-606K
33		10 pt. Futura Book Oblique	275	
34	6 pt. Sparten Medium Roman	7 pt. Futura Medium	289	6-6061
35	14 pt. Sparten Medium Roman	14 pt. Futura Medium	294	14-6061
36	18 pt. Sparten Medium Roman	18 pt. Futura Medium	295	18-6061
37	6 pt. Sparten Medium Italic	7 pt. Futura Medium Oblique	303	6-606K
38		10 pt. News Gothic	-	
39		12 pt. Light Copperslate Gothic Condensed	39	
40		6 pt. Copperslate Gothic Italic	124	

NOTE THE REPRESENTATION OF
INTERNATIONAL BOUNDARIES IS
NOT NECESSARILY AUTHENTIC

Classified by DIRECTOR DMA
EXEMPT FROM GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
EXEMPTION CATEGORY 1, 2, AND 3
DECLASSIFY ON DECEMBER 31,

NOT RELEASABLE TO CONTRACTOR
OR CONTRACTOR/CONSULTANTS
THIS INFORMATION HAS BEEN
AUTHORIZED FOR RELEASE TO

(3d)

CLASSIFICATION --19
SCALE 1:250,000 13
SAM NEUA, LAOS 13
SERIES 1501 RADAR
SHEET DDNF 48-14
2ND EDITION NOVEMBER 1975

LAOS - 13

VIETNAM - 12

Country names to be shown only
if more than one country exists
on graphic



13a

PREPARED AND PUBLISHED BY THE
DEFENSE MAPPING AGENCY AEROSPACE CENTER
ST. LOUIS AIR FORCE STATION, MISSOURI 63118.
Chart Compiled November 1975

USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS
FOR IMPROVING THIS PRODUCT TO DIRECTOR, DEFENSE
MAPPING AGENCY, AEROSPACE CENTER, ST. LOUIS
AFS, MISSOURI 63118. ATTN: PP.

Refer to DGR (1501 RADAR) Spec-
ifications Part I paragraph 1128 for the
appropriate downgrade note to be ap-
plied to domestic training materials

When CONTROL MARKING notes
are applied, prefix chart identifi-
cation numbers with the appro-
priate prefix letters

Add (Notes) when applicable

Release Contract Note (Conditions
of Release) Specified in Part I
paragraph 1126 of these Specifica-
tions will be published here when
required

3e

THIS CHART IS PREPARED FOR THE USE OF

WARNING NOTICE - SENSITIVE INTELLIGENCE
SOURCES AND METHODS INVOLVED

This information is furnished with the understanding
that it will not be disclosed or transmitted in any
manner to any other person without specific
authorization of the United States Government. It is not
to be used for other than military purposes and that
it will be removed substantially the same degree of
security protection afforded to it by the United States

All Type No. 3 except as noted

FOR REFERRING IN OVERLAP AREAS REFER TO THE ADJOINING GRAPHIC.			
TO GET A STANDARD INTERFERENCE ON THIS SHEET TO NEAREST 1000 METERS			
SAMPLE POINT PREFIXES			
1 Read letters preceding 1000 meter square in which the point lies	2 Enter last digit of point and read 1000 square using the 1st	3 Estimate within 1000 meter square the point and read 1000 square using the 1st	4 Enter last digit of point and read 1000 square using the 1st
5 Estimate within 1000 meter square the point and read 1000 square using the 1st	6 Enter last digit of point and read 1000 square using the 1st	7 Estimate within 1000 meter square the point and read 1000 square using the 1st	8 Enter last digit of point and read 1000 square using the 1st

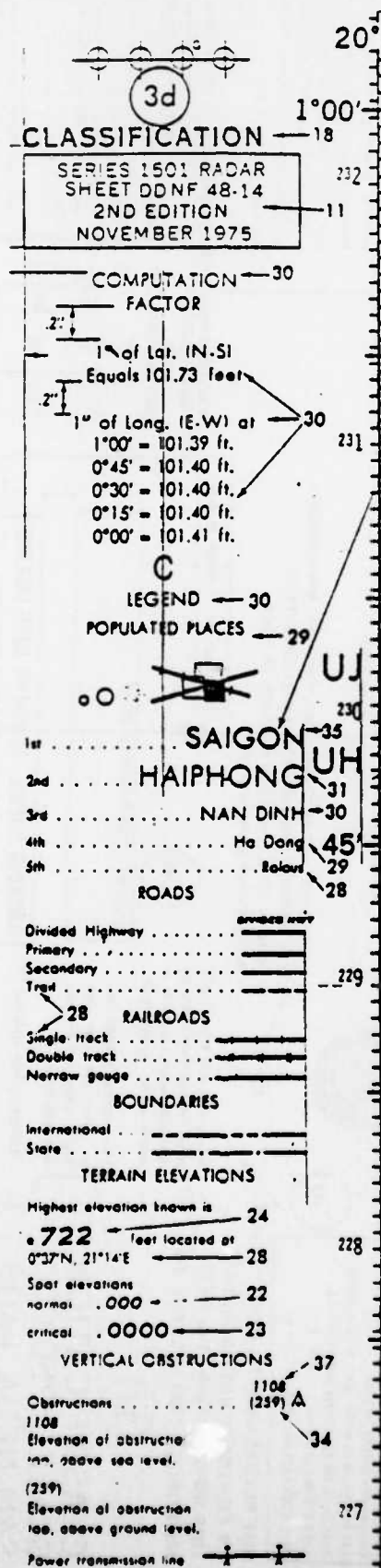
5f

16 ----- ELEVATIONS IN FEET








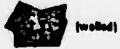












Reference notes shall be referred to
specific graphics. Major grid zone
lines shall be shown in the reference
box when they fall within a graphic.
(Refer to Section 1100 and 1300 and
Department of the Army Technical
Manual TM 5-241 II.)

FOR REFERRING IN OVERLAP AREAS REFER TO THE ADJOINING GRAPHIC.			
TO GET A STANDARD INTERFERENCE ON THIS SHEET TO NEAREST 1000 METERS			
SAMPLE POINT PREFIXES			
1 Read letters preceding 1000 meter square in which the point lies	2 Enter last digit of point and read 1000 square using the 1st	3 Estimate within 1000 meter square the point and read 1000 square using the 1st	4 Enter last digit of point and read 1000 square using the 1st
5 Estimate within 1000 meter square the point and read 1000 square using the 1st	6 Enter last digit of point and read 1000 square using the 1st	7 Estimate within 1000 meter square the point and read 1000 square using the 1st	8 Enter last digit of point and read 1000 square using the 1st

BLUE NUMBERED TICKS INDICATE THE 10,000-METER UNIVERSAL TRANSVERSE
MERIDIAN GRID ZONE AND TYPICAL SPAN ROAD



APPENDIX II

POPULATED PLACES AND LANDMARK FEATURES	COMPILATION		DRAFTING	
	Symbol	Specifications	Symbol	Specifications
Developed area limits known and area exceeding .15" at narrowest dimension		OUTLINE: 0.15mm (006 m) FILL: LIGHT BROWN		OUTLINE: 0.15mm (006 m) FILL: 67% 1200-45° TRAP FOR CASIR HOADS
Small developed area less than .15" at narrowest dimension		USE DRAFTING SPECIFICATIONS		LINEWEIGHT: 0.10mm (004 m) DIAMETER: 1.25mm (005 m)
Continuous habitation area (Kumpong)		OUTLINE: 0.15mm (006 m) FILL: YELLOW		OUTLINE: 0.15mm (006 m) FILL: 21% 1200-45° TRAP FOR CASIR HOADS
Walled city		OUTLINE: 0.25mm (010 m) FILL: LIGHT BROWN LETTERING: FREEMAN		OUTLINE: 0.25mm (010 m) FILL: 67% 1200-45° LABEL: 6 PT UNIVERS MEDIUM CONDENSED LOWER CASE
Landmark feature or object		SOLID SQUARE: 0.06mm (026 m) X 0.06mm (026 m) LETTERING: FREEMAN LABEL AS APPROPRIATE		SOLID SQUARE: 0.06mm (026 m) X 0.06mm (026 m) LABEL: 6 PT UNIVERS MEDIUM CONDENSED CAL
Building plottable to scale		SOLID: CORRECT SHAPE TO SCALE LETTERING: FREEMAN LABEL AS APPROPRIATE		SOLID: CORRECT SHAPE TO SCALE LABEL: 6 PT UNIVERS MEDIUM CONDENSED CAL
Small area of huts or kraals		USE DRAFTING SPECIFICATIONS		OPEN SQUARE: 0.06mm (026 m) X 0.06mm (026 m) LINEWEIGHT: 0.10mm (004 m)
School		USE DRAFTING SPECIFICATIONS		SOLID SQUARE: 0.06mm (026 m) X 0.06mm (026 m) STAFF LENGTH: 100mm (004 m) LINEWEIGHT: 0.10mm (004 m) FLAG: 0.75mm (003 m) PLAY TO 10° HEIGHT: 0.50mm (002 m)
Church		USE DRAFTING SPECIFICATIONS		SOLID SQUARE: 0.06mm (026 m) X 0.06mm (026 m) STAFF LENGTH: 100mm (004 m) CROSS: 0.06mm (026 m) CIRCUMFER: 0.10mm (004 m) HEIGHT: 0.10mm (004 m)
Mosque		USE DRAFTING SPECIFICATIONS		SOLID SQUARE: 0.06mm (026 m) X 0.06mm (026 m) STAFF LENGTH: 0.06mm (002 m) MINOR CIRCLE DIAMETER: 0.06mm (002 m) LINEWEIGHT: 0.10mm (004 m)

APPENDIX III

FEATURE CATEGORIES OF
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1

GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Aa	lava	center	
Academy	school	center	
Acclivity	slope	center	
Acequia	canal	center	
Addition	locale	center	
Adert	slope	center	
Adit	mine	center	
Agency	locale	center	
Aqua	stream	mouth	yes
Ahu	summit	top	
Aiguille	pillar	top	
Air Facility	military	center	
Air Force Base	military	center	
Air Station	military	center	
Airfield	airport	center	
Airport	airport	center	
Airstrip	airport	center	
Aisle	gap	center	
Alcove	cave	center	
Alluvial Fan	area	center	
Alluvium	area	center	
Alto	summit	top	
Ammunition Depot	military	center	
Ammunition Plant	military	center	
Amphibious Base	military	center	
Amphitheater	basin	center	
Anabranch	stream	mouth	yes
Anchorage	harbor	center	
Aqueduct	pillar	top	
Aqueduct	canal	center	
Arboretum	park	center	
Arch	arch	center	
Archipelago	island	center	
Area	area	center	
Arete *	ridge	center	
Arm	bay	center	
Army Depot	military	center	
Army Headquarters	military	center	
Army Post	military	center	
Arroyo	arroyo	mouth	yes
Arsenal	military	center	
Atoll	island	center	
Avawa	stream	mouth	yes
Backbone	ridge	center	
Backdeep	valley	mouth	yes
Backwater	lake	center	
Bailands	area	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Sahada	area	center	
Saie	bay	center	
Bald	summit	top	
Baldy	summit	top	
Balk	ridge	center	
Ball	ridge	center	
Bally	summit	top	
Balm	cave	center	
Banco	lake	center	
Bank	bar	center	
Bank	levee	center	
Bar	bar	center	
Baraboo	summit	top	
Barchan	summit	top	
Barracks	military	center	
Barranca	valley	mouth	yes
Barrens	area	center	
Barrier Beach	island	center	
Barrier Island	island	center	
Barrio	civil	center	
Basin	basin	center	
Battle Field	locale	center	
Battlefield	locale	center	
Batture	summit	top	
Bay	bay	center	
Bayqall	swamp	center	
Bayqul	swamp	center	
Bayou (flowing)	stream	mouth	yes
Bayou (stagnant)	gut	center	
Beach (populated)	ppl	center	
Beach (unpopulated)	beach	center	
Beacon	other	center	
Bed	flat	center	
Beigh	ppl	center	
Ben	peak	top	
Bench	bench	center	
Bend	berd	center	
Berg	summit	top	
Bern	ridge	center	
Bight	bay	center	
Sill	cape	center	
Blowhole	cave	center	
Blowout	basin	center	
Bluff	cliff	center	
Boca	area	center	
Rocca	crater	center	
Boq	swamp	center	
Soqan	swamp	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Boque (flowing)	stream	mouth	yes
Boque (still)	lake	center	
Bolly	summit	top	
Bolson	basin	center	
Borehole	well	center	
Boro	ppl	center	
Borough	ppl	center	
Borough	civil	center	
Bot	bend	center	
Bottleneck	bay	center	
Bottom	bend	center	
Boulder	summit	top	
Bourne	stream	mouth	yes
Bowl	basin	center	
Box	valley	mouth	yes
Box Canyon	valley	mouth	yes
Bracket	area	center	
Brake	swamp	center	
Brake	stream	mouth	yes
Brake	woods	center	
Branch	stream	mouth	yes
Bray	summit	top	
Breachway	cut	center	
Breakers	area	center	
Breaks	area	center	
Breakwater	dam	center	
Bridal Veil	falls	center	
Bridge	bridge	center	
Broad	area	center	
Brook	stream	mouth	yes
Brow	cliff	center	
Building	building	center	
Bur	ppl	center	
Burg	ppl	center	
Burgh	ppl	center	
Burial	cemetery	center	
Burn	stream	mouth	yes
Burn	area	center	
Bury	ppl	center	
Burying Ground	cemetery	center	
Butt	summit	top	
Butte	summit	top	
Buttress	cliff	center	
By	ppl	center	
Cabin	locale	center	
Cairn	park	center	
Cajon	valley	mouth	yes
Cala	stream	mouth	yes

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Caldera	crater	center	
Caldron	basin	center	
Caleta	stream	mouth	yes
Callow	area	center	
Cam	stream	mouth	yes
Camas	flat	center	
Camass	flat	center	
Camp	locale	center	
Campagna	plain	center	
Campground	locale	center	
Campus	school	center	
Canada *	valley	mouth	yes
Canal	canal	center	
Candelas	pillar	top	
Canon *	valley	mouth	yes
Canyon	valley	mouth	yes
Cap	cape	center	
Cape	cape	center	
Capilla	church	center	
Carse	beni	center	
Cas	pillar	top	
Casa	building	center	
Cascade	falls	center	
Caster	ppl	center	
Castle	pillar	top	
Cataract	falls	center	
Catchment	basin	center	
Causeway	bridge	center	
Cave	cave	center	
Cavern	cave	center	
Caverns	cave	center	
Cay	island	center	
Cayo	island	center	
Ceja	cliff	center	
Cellar	cave	center	
Cemetery	cemetery	center	
Cerrillo	summit	top	
Cerrito	summit	top	
Cerro	summit	top	
Cester	ppl	center	
Cey	island	center	
Chain	range	center	
Champaign	plain	center	
Channel (man-made)	canal	center	
Channel (natural)	channel	center	
Chapel	church	center	
Charco	lake	center	
Chasm	valley	mouth	yes

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Chester	ppl	center	
Chimney	pillar	top	
Chine	valley	mouth	yes
Chuck	bay	center	
Church	church	center	
Chute	stream	mouth	yes
Chute	gut	center	
Chute	channel	center	
Cienaga	swamp	center	
Cinder	summit	top	
Cirque	basin	center	
Cistern	reservoir	center	
City (administrative)	civil	center	
City (populated place)	ppl	center	
Civil Division	civil	center	
Claim	civil	center	
Clearing	flat	center	
Cleft	valley	mouth	yes
Cleuch	valley	mouth	yes
Cleugh	valley	mouth	yes
Cliff	cliff	center	
Clint	flat	center	
Clove	valley	mouth	yes
Cluse	valley	mouth	yes
Coast	beach	center	
Coast Guard Base	military	center	
Coast Guard Lifeboat Station	military	center	
Coastline	beach	center	
Col	gap	center	
Colina	summit	top	
Collado	summit	top	
College	school	center	
Colline	summit	top	
Column	pillar	top	
Comb	ridge	center	
Combe	valley	mouth	yes
Common	park	center	
Community	ppl	center	
Cone	summit	top	
Confluence	head	center	
Constriction	gap	center	
Coombe	valley	mouth	yes
Cordillera	range	center	
Corner	locale	center	
Corner	ppl	center	
Corners	locale	center	
Corral	locale	center	
Corridor	gap	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Corrie	basin	center	
Coteau	area	center	
Coulee	arroyo	mouth	yes
Coulee	valley	mouth	yes
Couloir	valley	mouth	yes
Coulter	beach	center	
Ccountry Club	other	center	
County	civil	center	
Court House	building	center	
Cove	slope	center	
Cove (land)	valley	mouth	yes
Cove (water)	bay	center	
Crag	cliff	center	
Crater	crater	center	
Creek	stream	mouth	yes
Crest (linear)	ridge	center	
Crest (top)	summit	top	
Crevasse (earth)	valley	mouth	yes
Crevasse (ice)	glacier	center	
Crossing	locale	center	
Crossroads	locale	center	
Cuchilla	ridge	center	
Cuesta	ridge	center	
Cumb	valley	mouth	yes
Cumbre	summit	top	
Current	stream	mouth	yes
Curve	bend	center	
Cusp	beach	center	
Cut	channel	center	
Cutbank	levee	center	
Cutoff	bend	center	
Cutoff	channel	center	
Dairy	locale	center	
Dale	valley	mouth	yes
Dalles	cliff	center	
Dam	dam	center	
Danger	bar	center	
Deadening	swamp	center	
Headwater	area	center	
Debouchure	area	center	
Declivity	slope	center	
Deep	area	center	
Defile	gap	center	
Dell	valley	mouth	yes
Delta	area	center	
Demoiselles	pillar	top	
Depression	basin	center	
Descent	slope	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Desert	plain	center	
Dike	levee	center	
Dingle	valley	mouth	yes
Dismal	swamp	center	
Distributary	stream	mouth	yes
District	civil	center	
Ditch	canal	center	
Divide	ridge	center	
Division	civil	center	
Doab	cape	center	
Dock	locale	center	
Dockyard	locale	center	
Dol	valley	mouth	yes
Dolina	basin	center	
Doline	basin	center	
Dome	summit	top	
Donga	valley	mouth	yes
Down	flat	center	
Downs	other	center	
Draft	valley	mouth	yes
Dragway	other	center	
Drain (man-made)	canal	center	
Drain (natural)	stream	mouth	yes
Draw (deep)	valley	mouth	yes
Draw (shallow)	arroyo	mouth	yes
Drift	summit	top	
Drop	falls	center	
Drum	summit	top	
Drumlin	summit	top	
Drumlinoid	summit	top	
Drumlond	summit	top	
Drywash	arroyo	mouth	yes
Dugout	channel	center	
Dun	summit	top	
Dune	summit	top	
Dustwell	basin	center	
Dvip	summit	top	
Eddy	rapids	center	
Eddy	bay	center	
Elbow	bend	center	
Elevation	summit	top	
Embankment	levee	center	
Embayment	bay	center	
Embouchure	area	center	
Eminence	summit	top	
Entrance	cut	center	
Erg	plain	center	
Escarpment	cliff	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Esker	ridge	center	
Estate	locale	center	
Estero	bay	center	
Estero	stream	mouth	yes
Estuary	bay	center	
Everglade	swamp	center	
Exclosure	locale	center	
Pyot	island	center	
Fairgrounds	locale	center	
Fairway	channel	center	
Palaises	cliff	center	
Fall	falls	center	
Falls	falls	center	
Fan	area	center	
Farm	locale	center	
Faro	island	center	
Fault	valley	mouth	yes
Feeder	stream	mouth	yes
Fell	summit	top	
Pen	swamp	center	
Ferry	locale	center	
Field	park	center	
Fields	flat	center	
Fill	summit	top	
Finger	pillar	top	
Finger	lake	center	
Fjord	valley	mouth	yes
Firetower	locale	center	
Firing Center	military	center	
Firing Range	military	center	
Firn	glacier	center	
Firth	bay	center	
Fishing Ground	area	center	
Pissure	valley	mouth	yes
Flat	flat	center	
Platiron	summit	top	
Flatwoods	swamp	center	
Flooding	reservoir	dam	
Floodplain	swamp	center	
Floodway	channel	center	
Floor	flat	center	
Flovage	reservoir	center	
Flume (man-made)	canal	center	
Flume (natural)	valley	mouth	yes
Fly	swamp	center	
Fly	stream	mouth	yes
Fold	summit	top	
Foot	locale	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Foot	area	center	
Foot hills	summit	top	
Ford	locale	center	
Foredune	summit	top	
Foreland	cliff	center	
Foreside	beach	center	
Forest (administrative)	forest	center	
Forest (natural)	area	center	
Forge	locale	center	
Fork	stream	mouth	yes
Port	locale	center	
Foso	stream	mouth	yes
Fosse	stream	mouth	yes
Foulground	bar	center	
Foundry	locale	center	
Fountain	geyser	center	
Freshet	stream	mouth	yes
Fulfe	basin	center	
Fumaroles	geyser	center	
Funnel	gap	center	
Furnace	locale	center	
Furrow	valley	mouth	yes
Galera	ridge	center	
Game Management Area	park	center	
Game Reserve	park	center	
Gap	gap	center	
Garden	area	center	
Gate	gap	center	
Gate	channel	center	
Geyser	geyser	center	
Ghost Town	locale	center	
Gill	valley	mouth	yes
Glacier	glacier	center	
Glacis	slope	center	
Glide	flat	center	
Glen	valley	mouth	yes
Gloryhole	mine	center	
Goe	cave	center	
Goldfield	area	center	
Gorge	valley	mouth	yes
Graben	valley	mouth	yes
Grade	slope	center	
Gradient	slope	center	
Graike	basin	center	
Grange	locale	center	
Grange Hall	locale	center	
Grant	civil	center	
Grassland	plain	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Grave	cemetery	center	
Gravel Fan	area	center	
Grotto	cave	center	
Ground	shoal	center	
Grove	woods	center	
Guard Station	locale	center	
Gulch	valley	mouth	yes
Gulf (land)	valley	mouth	yes
Gulf (water)	bay	center	
Gulley	arroyo	mouth	yes
Gully	valley	prime	yes
Gut	cut	center	
Hall	locale	center	
Ham	ppl	center	
Hamada	plain	center	
Hamlet	ppl	center	
Hammock	island	center	
Hamongoo	summit	top	
Hamp	ppl	center	
Harbor (man-made)	harbor	center	
Harbor (natural)	bay	center	
Hat	flat	center	
Haven	harbor	center	
Head	summit	top	
Head (hill)	summit	top	
Head (steep face)	cliff	center	
Headland	cliff	center	
Headwall	cliff	center	
Headwaters	stream	mouth	yes
Heath	flat	center	
Heath	swamp	center	
High School	school	center	
Highland	area	center	
Hill	summit	top	
Hillock	summit	top	
Hills	range	center	
Hirst	levee	center	
Hogback	ridge	center	
Hole	valley	mouth	yes
Hole	lake	center	
Hole (land)	bend	center	
Hole (water)	bay	center	
Hollow	valley	mouth	yes
Homestead	locale	center	
Hono	harbor	center	
Hoodooos	ridge	center	
Hook	cape	center	
Hook	bar	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Horn	summit	top	
Horseback	ridge	center	
Horseshoe	lake	center	
Horseshoe	pond	center	
Horst	summit	top	
Hospital	hospital	center	
Hot Spring	spring	center	
Huerfano	summit	top	
Hum	summit	top	
Hummock	island	center	
Hump	summit	top	
Hurst	summit	top	
Ice Patch	glacier	center	
Icecap	glacier	center	
Icefall	glacier	center	
Icefield	glacier	center	
Icesheet	glacier	center	
Indian Reservation	reserve	center	
Infirmery	hospital	center	
Inlet	stream	mouth	yes
Inlet (channel)	gut	center	
Inlet (water body)	bay	center	
Inn	locale	center	
Institute	school	center	
Intercolline	gap	center	
Interfluve	swamp	center	
Intervale	swamp	center	
Intervale	basin	center	
Island(s)	island	center	
Isle	island	center	
Islet	island	center	
Isthmus	isthmus	center	
Jams	valley	mouth	yes
Jean Trail	trail	center	
Jetty	dam	center	
Jumpoff	cliff	top	
Junction	locale	center	
Kame	summit	top	
Kar	basin	center	
Karoo	plain	center	
Karst	area	center	
Keana	cave	center	
Kernbut	summit	top	
Kettle	basin	center	
Kettlehole	basin	center	
Key	island	center	
Mill	stream	mouth	yes
Mipuka	island	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Xipuka	lava	center	
Kirk	church	center	
Knob	summit	top	
Knoll	summit	top	
Kula	plain	center	
Lac	lake	center	
Lae	ridge	center	
Lae	cape	center	
Lagoon (open water)	lake	center	
Lagoon (vegetation)	swamp	center	
Laguna	lake	center	
Lake (s)	lake	center	
Lakebed	flat	center	
Land Grant	civil	center	
Landfall	slope	center	
Landing	locale	center	
Landing Field	airport	center	
Landing Strip	airport	center	
Landslide	slope	center	
Landslip	slope	center	
Lateral	canal	center	
Lava	lava	center	
Lava Cone	lava	center	
Lava Delta	lava	center	
Lava Field	lava	center	
Lava Flow	lava	center	
Lava Pit	crater	center	
Lava Plain	lava	center	
Lava Plateau	lava	center	
Lava Tongue	lava	center	
Lava Tube	lava	center	
Lea	plain	center	
Leach Hole	cave	center	
Lead	ridge	center	
Ledge (land)	bench	center	
Ledge (water)	bar	center	
Lenticular	summit	top	
Levee	levee	center	
Level	flat	center	
Lick	area	center	
Lick	stream	mouth	yes
Lighthouse	locale	center	
Littoral	beach	center	
Llano	area	center	
Locale (little or no population)	locale	center	
Locality	locale	center	
Loch	lake	center	
Logan	swamp	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Loma	summit	top	
Loma	summit	top	
Longshore Bar	bar	center	
Lookout	locale	center	
Loop	bend	center	
Loop Lake	lake	center	
Lough	lake	center	
Lowland	flat	center	
Lowmoor	swamp	center	
Lua	crater	center	
Lump	island	center	
Lunatt	bar	center	
Maar	crater	center	
Malaspina	glacier	center	
Malpais	area	center	
Mamelon	summit	top	
Mangrove	swamp	center	
Mar	sea	center	
Marais	swamp	center	
Maremar	swamp	center	
Marina	locale	center	
Marine Corps Air Station	military	center	
Marine Corps Base	military	center	
Market	locale	center	
Marsh	swamp	center	
Mass	summit	top	
Massif	range	center	
Matterhorn	summit	top	
Mauna	summit	top	
Meadow	flat	center	
Meander	bend	center	
Meander Core	bend	center	
Medano	summit	top	
Meetinghouse	church	center	
Memorial Garden	cemetery	center	
Mendip	summit	top	
Mer	sea	center	
Mesa	summit	top	
Meseta	summit	top	
Mesita	summit	top	
Mesita	summit	top	
Midway	channel	center	
Military Reservation	military	center	
Mill	locale	center	
Millpond	reservoir	dam	
Milltown	locale	center	
Mine	mine	center	
Mire	swamp	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Missile Base	military	center	
Missile Range	military	center	
Mission	church	center	
Mofette	valley	mouth	yes
Moku	island	center	
Mole	dam	center	
Monadnock	summit	top	
Monastery	church	center	
Monolith	pillar	top	
Mont	summit	top	
Monte	summit	top	
Monticle	crater	center	
Monticule	crater	center	
Monument	pillar	top	
Monument	park	center	
Moor	flat	center	
Mor	flat	center	
Moraine (area)	summit	top	
Moraine (linear)	ridge	center	
Morais	swamp	center	
Morass	swamp	center	
Morenna	swamp	center	
Morriner	ridge	center	
Mosque	church	center	
Mott	summit		
Mott	woods	center	
Motte	summit	top	
Motte	cliff	top	
Moulin	glacier	center	
Mound	summit	top	
Mount	summit	top	
Mountain	summit	top	
Mountain Chain	range	center	
Mountain Group	range	center	
Mountain Range	range	center	
Mountain System	range	center	
Mountains	range	center	
Mountainside	cliff	center	
Mouth	area	center	
Mud Cone	summit	top	
Mud Flat	flat	center	
Mud Pot	spring	center	
Mudflow	slope	center	
Mull	cape	center	
Municipality	civil	center	
Municipio *	civil	center	
Muskeg	swamp	center	
Narrow	pass	center	

FEATURE CATEGORIES OF
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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Narrows	gap	center	
Narrows	channel	center	
Narrows	ridge	center	
Natatorium	other	center	
National Forest	forest	center	
National Grasslands	forest	center	
National Historical Landmark	park	center	
National Monument	park	center	
National Park (administrative)	park	center	
National Seashore	park	center	
National Wilderness Area	park	center	
National Wildlife Area	park	center	
Natural Bridge	arch	center	
Naval Air Station	military	center	
Naval Base	military	center	
Naval Shipyard	military	center	
Maze	cliff	center	
Neck	cape	center	
Needle	pillar	top	
Ness	cape	center	
Neve *	glacier	center	
Niche	cave	center	
Nip	cave	center	
Nipple(s)	summit	top	
Nobble	summit	top	
Nose	cliff	center	
Nose	summit	top	
Notch	gap	center	
Notch	channel	center	
Nubble	summit	top	
Nubble	island	center	
Nullah	valley	mouth	yes
Nunatak	summit	top	
Oasis	spring	center	
Ocean	sea	center	
Offset	ridge	center	
Offshore Bar	bar	center	
Oil Pumping Station	oilfield	center	
Oilfield	oilfield	center	
Oilwell	well	center	
Ofito	spring	center	
Ojo	spring	center	
Open	flat	center	
Open Bay	bay	center	
Orchard	locale	center	
Ordinary	locale	center	
Ordnance Laboratory	military	center	
Ordnance Plant	military	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Os	ridge	center	
Osar	ridge	center	
Outcrop	summit	top	
Outlet	channel	center	
Outlet	stream	mouth	yes
Outwash	plain	center	
Overfall	rapids	center	
Overhang	cliff	center	
Overlook	locale	center	
Overpass	bridge	center	
Oxbow	bend	center	
Oxbow	lake	center	
Pagoda	church	center	
Pahas	summit	top	
Pali	cliff	center	
Palisades	cliff	center	
Pampas	plain	center	
Pan	flat	center	
Panplain	plain	center	
Paramilla	range	center	
Paramo	area	center	
Parish	civil	center	
Park (Administrative)	park	center	
Park (natural)	flat	center	
Pass	gap	center	
Pass	channel	center	
Passage (navigation)	channel	center	
Passage (portage)	locale	center	
Pasture	flat	center	
Path	trail	center	
Peak	summit	top	
Pediment	slope	center	
Pen	locale	center	
Pena *	pillar	top	
Penasco *	pillar	top	
Peneplain	plain	center	
Peninsula	cape	center	
Peninsula	cape	center	
Pepino	summit	top	
Picacho	summit	top	
Picnic Area	locale	center	
Pico	summit	top	
Pier	locale	center	
Pile	summit	top	
Pillar	pillar	top	
Pingo	summit	top	
Pinnacle	pillar	top	
Pit	basin	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Pit	mine	center	
Pitch	slope	center	
Placer	area	center	
Plain	plain	center	
Plains	plain	center	
Plantation	locale	center	
Plantation	civil	center	
Plantation	ppl	center	
Plat	plain	center	
Plateau	plain	center	
Platform	bench	center	
Playa	area	center	
Plaza (cultural)	locale	center	
Plaza (physical)	area	center	
Pocket	basin	center	
Pocosin	swamp	center	
Pohaku	pillar	center	
Point	ridge	center	
Point	summit	top	
Point (peninsula)	cape	center	
Point (promontory)	cliff	center	
Polder	flat	center	
Pelje	basin	center	
Polye	basin	center	
Pond (man-made)	reservoir	dam	
Pond (natural)	lake	center	
Ponor	basin	center	
Pool (man-made)	reservoir	dam	
Pool (natural)	lake	center	
Port	harbor	center	
Port	ppl	center	
Port of Entry	locale	center	
Portage	locale	center	
Portal	gap	center	
Portal	tunnel	center	
Portal	mine	center	
Pothole	basin	center	
Potrero	flat	center	
Pozo	reservoir	center	
PPL (Populated Place)	ppl	center	
Prairie	area	center	
Precinct	civil	center	
Precipice	cliff	center	
Projection	cliff	center	
Promontory	cliff	center	
Prong	stream	mouth	yes
Puerta	gap	center	
Puertecito	gap	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Puerto	gap	center	
Puerto (land)	gap	center	
Puerto (water)	harbor	center	
Puffing Hole	cave	center	
Punta	summit	top	
Pup	stream	mouth	yes
Purgatory	cave	center	
Puu	summit	top	
Quagmire	swamp	center	
Quaking Bay	swamp	center	
Quarry	mine	center	
Quarry	basin	center	
Quartermaster Depot	military	center	
Quay	locale	center	
Quebrada	valley	mouth	yes
Race	stream	mouth	yes
Race	area	center	
Railroad Siding	locale	center	
Railroad Station	building	center	
Railroad Stop	locale	center	
Rainpool	lake	center	
Ramble	valley	mouth	yes
Ranch	locale	center	
Ranch	slope	center	
Rancho	civil	center	
Range	channel	center	
Range	range	center	
Rapids	rapids	center	
Ravine	valley	mouth	yes
Razorback	ridge	center	
Reach	area	center	
Reef	ridge	center	
Reef	bar	center	
Reentrant	head	center	
Refuge	park	center	
Reg	plain	center	
Remnant	summit	top	
Resaca	lake	center	
Research Station	other	center	
Reserve	forest	center	
Reserve	park	center	
Reserve	reserve	center	
Reserve Training Center	military	center	
Reservoir	reservoir	dam	
Resort	ppl	center	
Retreat	locale	center	
Revetment	levee	center	
Ris	bay	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Ridge	ridge	center	
Riffle	rapids	center	
Rift	valley	mouth	yes
Fill	stream	mouth	yes
Rim	cliff	center	
Rimrock	cliff	center	
Pincon	valley	mouth	yes
Pio	stream	mouth	yes
Pio	area	center	
Ripole	rapids	center	
Rips	rapids	center	
Rito	stream	mouth	yes
River	stream	mouth	yes
River Basin	basin	center	
River Bed	channel	center	
River Bottom	bend	center	
River Valley	valley	mouth	yes
Riveret	stream	mouth	yes
Riviere *	stream	mouth	yes
Rivulet	stream	mouth	yes
Roads	bay	center	
Roadstead	harbor	center	
Roche Moutonnee	summit	top	
Rock	bar	center	
Rock	island	center	
Rock (massive)	summit	top	
Rock (singular)	pillar	top	
Rock Slide	slope	center	
Rock Tower	pillar	center	
Rockfall	slope	center	
Rodeo Grounds	locale	center	
Potnon	summit	top	
Pookery	island	center	
Rough	ridge	center	
Ruins	locale	center	
Run	stream	mouth	yes
Runnel	stream	mouth	yes
Saddle	gap	center	
Saddleback	ridge	center	
Sag	gap	center	
Sagpond	lake	center	
Salient	ridge	center	
Salina	flat	center	
Salt Bottom	flat	center	
Salt Flat	flat	center	
Salt Lick	flat	center	
Salt Marsh	flat	center	
Salt Prairie	flat	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Saltpan	flat	center	
Salturn	flat	center	
Sanctuary	park	center	
Sand	beach	center	
Sand Drift	summit	top	
Sand Dune	summit	top	
Sand Flat	flat	center	
Sandbank	bar	center	
Sandbar	bar	center	
Sandia	summit	top	
Sandkey	island	center	
Sandwash	arroyo	mouth	yes
Sault	rapids	center	
Savanna	plain	center	
Sawback	range	center	
Scabland	area	center	
Scabrock	area	center	
Scar	cliff	center	
Scarp	cliff	center	
Scaur	cliff	center	
School	school	center	
School	school	center	
School District	civil	center	
Scree	slope	center	
Scrub	woods	center	
Scrubland	area	center	
Sea (continental)	sea	center	
Sea (inland)	lake	center	
Sea Arch	arch	center	
Sea Cave	cave	center	
Sea Mount	pillar	top	
Sea Stack	summit	top	
Sea Wall	levee	center	
Seaboard	beach	center	
Seacoast	beach	center	
Seige	swamp	center	
Sedge	island	center	
Seep	spring	center	
Serrate	summit	top	
Settlement	ppl	center	
Shaft	mine	center	
Shake	cave	center	
Shaw	woods	center	
Sheep Camp	locale	center	
Sheepback	summit	top	
Shelf	bar	center	
Shelter	locale	center	
Shingle	beach	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Shire	civil	center	
Shoal	bar	center	
Shop	locale	center	
Shore	beach	center	
Shoreline	beach	center	
Shoulder	slope	center	
Shrine	church	center	
Siding	locale	center	
Sierra	range	center	
Silo	ppl	center	
Silva	woods	center	
Sink	basin	center	
Sinkhole	basin	center	
Site	locale	center	
Skerry	island	center	
Ski Trail	trail	center	
Slang	area	center	
Slash	swamp	center	
Slash	stream	mouth	yes
Slide	slope	center	
Slip	locale	center	
Slope	slope	center	
Slough	lake	center	
Slough (flowing)	stream	mouth	yes
Slough (stagnant)	gut	center	
Slue (not open channel)	swamp	center	
Slue (open channel)	gut	center	
Sluice	canal	center	
Sluice Gate	dam	center	
Snow Patch	glacier	center	
Snowfield	glacier	center	
Solfatara	summit	top	
Scuml	bay	center	
Sowback	ridge	center	
Spu	locale	center	
Space Flight Center	military	center	
Spoolway	other	center	
Spillway	canal	center	
Spire	pillar	top	
Spit	bar	center	
Spoil Bank	bar	center	
Spring	spring	center	
Springs	spring	center	
Spur	ridge	center	
Spur	trail	center	
Square	park	center	
Stack	pillar	top	
State Forest	forest	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
State Park	park	center	
Station (no population)	locale	center	
Station (populated)	ppl	center	
Stead	ppl	center	
Steel	ppl	center	
Steephead	cliff	center	
Steppe	plain	center	
Steptoe	lava	center	
Stillwater	area	center	
Stock Trail	trail	center	
Stone	cliff	top	
Store	locale	center	
Strait	channel	center	
Strand	beach	center	
Strand	swamp	center	
Strath	flat	center	
Stream	stream	mouth	yes
Stretch	channel	center	
Stringer	stream	mouth	yes
Subsidence	basin	center	
Suburb	ppl	center	
Suck	swamp	center	
Sugar Loaf	summit	top	
Sugarloaf	summit	top	
Summit (cultural)	locale	center	
Summit (physical)	summit	top	
Supply Center	military	center	
Supply Depot	military	center	
Swag	gap	center	
Swale	valley	mouth	yes
Swallow	basin	center	
Swallow Hole	cave	center	
Swamp	swamp	center	
Swamp	stream	mouth	yes
Swash	bar	center	
Synagogue	church	center	
Tabernacle	church	center	
Table	summit	top	
Table Mountain	summit	top	
Tableland (+ 2 mi. across)	area	center	
Tableland (- 3 mi. across)	summit	top	
Taiqa	woods	center	
Talus	slope	center	
Tank	reservoir	dam	
Tanque	reservoir	center	
Tarai	swamp	center	
Tarn	lake	center	
Tavern	locale	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT PEQ
Teat	summit	top	
Temple	church	center	
Ten	ppl	center	
Tepee	pillar	top	
Terrace	bench	center	
Terrain	plain 	center	
Terrane	plain	center	
Terrene	plain	center	
Test Center	military	center	
Test Range	military	center	
Teton	summit	top	
Thalweg	valley	mouth	yes
Thicket	woods	center	
Thorofare	channel	center	
Thorofare	cut	center	
Thoroughfare	channel	center	
Thoroughfare	gap	center	
Thorpe	ppl	center	
Throat	stream	mouth	yes
Thrumcap	island	center	
Thumb	pillar	top	
Thurn	cliff	center	
Thwaite	flat	center	
Tickle	cut	center	
Tidal Creek	cut	center	
Tidal Flat	flat	center	
Tidal Inlet	cut	center	
Tidal Marsh	swamp	center	
Tideland	flat	center	
Tiderace	stream	mouth	yes
Tie	bar	center	
Tin	ppl	center	
Tit (s)	summit	top	
Toe	summit	top	
Toe	cape	center	
Toll House	locale	center	
Tombolo	isthmus	center	
Ton	ppl	center	
Tongue	cape	center	
Tooth	pillar	top	
Top	summit	top	
Top	cape	center	
Tor	summit	top	
Torrent	rapids	center	
Tower	tower	center	
Tower (+ 500 ft. across)	summit	top	
Tower (- 500 ft. across)	pillar	top	
Towhead	island	center	

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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Town	civil	center	
Town (populated place)	ppl	center	
Township	civil	center	
Trace	trail	center	
Trace	stream	mouth	yes
Track	trail	center	
Trail	trail	center	
Transverse	valley	mouth	yes
Trench	valley	mouth	yes
Trestle	bridge	center	
Tributary	stream	mouth	yes
Trough	valley	mouth	yes
Tule	swamp	center	
Tulelands	swamp	center	
Tump	island	center	
Tun	ppl	center	
Tunira	plain	center	
Tunnel	tunnel	center	
Tying	bar	center	
University	school	center	
Upbac	slope	center	
Upland	plain	center	
Uvala	basin	center	
Vale	valley	mouth	yes
Valle	valley	mouth	yes
Valley	valley	mouth	yes
Veldt	plain	center	
Versant	slope	center	
Viaduct	bridge	center	
Village	ppl	center	
Vlei	valley	mouth	yes
Vley	valley	mouth	yes
Vloer	flat	center	
Vly	valley	mouth	yes
Vly	swamp	center	
Vly	stream	mouth	yes
Vox	bay	center	
Volcano	summit	top	
Wadi	arroyo	mouth	yes
Wall	cliff	center	
Wallow	basin	center	
Wash	arroyo	mouth	yes
Wash	valley	mouth	yes
Washover	flat	center	
Waste Bank	bar	center	
Wasteland	area	center	
Wasteway	canal	center	
Water	bay	center	

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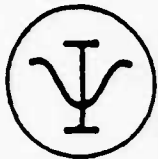
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GENERIC/WORD	FEATURE CLASS	PRIME POINT	SOURCE POINT REQ
Water Gap	gap	center	
Water Passage	gut	center	
Water Pocket	lake	center	
Water Sink	basin	center	
Watercourse (dry)	arroyo	mouth	yes
Watercourse (flowing)	stream	mouth	yes
Waterfall	falls	center	
Waterfront	harbor	center	
Waterhole (area)	lake	center	
Waterhole (point)	spring	center	
Waterpan	lake	center	
Watershed	ridge	center	
Watertank	reservoir	dam	
Waterway	gut	center	
Waterway	channel	center	
Wayside	locale	center	
Weapons Range	military	center	
Well	well	center	
Wetland	flat	center	
Whaleback	summit	top	
Wharf	locale	center	
Whirlpool	rapids	center	
Wich	ppl	center	
Wick	ppl	center	
Wind Gap	gap	center	
Windmill	locale	center	
Winged Headland	cliff	center	
Woodland	woods	center	
Woods	woods	center	
Worth	ppl	center	
Yacht Club	other	center	
Yarl	locale	center	
Yardang	valley	mouth	yes

- * Indicates the presence of a diacritical mark within the name
- ** Developed by Geographic Names Information Management,
Branch of Geographic Names, Office of Geographic Research,
National Mapping Division, U. S. Geological Survey

1,185 RECORDS PRINTED

APPENDIX IV



Planning Systems Incorporated

Suite 600 ■ 7900 Westpark Drive ■ McLean, Va. 22102 ■ (703) 734-3400

MEMORANDUM

TO : Dr. Barry Glick, Par Technology Corp.
FROM: Dr. Allen Barnes, Planning Systems Inc.
DATE: 23 December 83
SUBJ: Interface between AADES and GNDB; preliminary ideas.

1. The following information will be used by the Geographic Names Data Base. For initial data loading, this data will come from the Automated Alphanumeric Data Entry System. As many fields should be provided as possible by AADES from its input material. An 'R' following the entity name means the entity is required for each data record. Otherwise, the GNDB will accept the record with that field blank or zero.

Country	R
Data Source Name	-
Date of Data Capture by AADES	-
Geographic Name	R
Typed Romanization	-
Position	R
Positional Accuracy	R
Feature Designator	-
> Feature Attribute	-
Boundary Points	-
Non-Romanized Name	-
Alphabet Translation Table	-
Pointer to file containing boundary data	-

Note: If a non-Romanized name is given, then an alphabet translation table must be given.

2. For flexibility, I recommend that AADES build a file (e.g. on disk), and after completion, the GNDB operator will input that file. This avoids complicated systems of circular buffer update files, concurrency contracts, automatic job invocation, etc.

- 2
3. It is obvious that if one is digitizing geographic names from a map, that some of the above entities will be the same for each data record (e.g. Data Source Name, Date of Data Capture) and that some will be the same for large blocks of geographic names (e.g. Country, Type of Romanization, Alphabet translation table). Thus for such fields, I assume that the AADES operator would enter all of them initially, and re-enter individual ones whenever they change, but would not enter these common entities each time a geographic name is identified and digitized.

Thus a natural approach to the interface file is to have two types of records: a 'header' record containing parameter values which apply to the set of data records, and the individual data records. When one of the parameters in the header changes value, a new header is used. This would result in an interface file which reflects the AADES operator's inputs.

An alternative, which is simpler but requires more disk space, would be to write all data entities in the data record. Duplication of parameter values on all records would not slow processing by any noticeable amount, and would mean that software would only have to read/write one typed record. This seems preferable.

4. Another aspect of the record structure for the interface file is the name length problem. Most geographic names are less than 20 characters, but there are some names over 40 characters long (not counting diacritics). Also, non-Romanized names will appear only when inputting bilingual or non-Romanized maps into AADES. If variable length records are used, there is no problem with wasted space or very long names. If fixed length records are used, often the file will either require some form of overflow area for long names, or will contain much wasted space (due to setting very large name fields).

Since the interface files are only temporary (i.e. after GNDB uses the file, it may be scratched) it seems preferable to use the simpler approach of large name fields in fixed-length records.

5. Specifications of individual data entities

- Country: Alphanumeric, 20 characters maximum. Can be an alias name (e.g. USSR or CCCP for the full name), but the alias must be identifiable by the GNDB. Otherwise the entire file will be rejected.
- Data Source Name: Alphanumeric, 10 characters maximum. If the entered name does not match any existing name known to the GNDB, then the GNDB will add it to the list of legal data source names. Thus aliases should never be used here, for this would adversely affect retrievals based on data source names. DMA should decide on an appropriate set of data source names, to avoid alias problems.
- Position: Signed numeric string, 8 digits including sign. I assume the AADES will initially digitize the position in rectangular units relative to the particular map being 'read'. However,

such units are not very useful for maps of other sizes or projections. Thus all positions should be converted to latitude and longitude. There are a variety of ways to record latitude and longitude, e.g.

Degrees, minutes, seconds and hemisphere
(e.g. 135°30'45"E)

Degrees, decimal minutes and hemisphere
(e.g. 135°30.75'E)

Signed decimal degrees
(e.g. - 135.5125)

Signed decimal minutes
(e.g. - 8130.75)

The first two examples are easy for the human, but computer software doesn't particularly care for base 60 conversions, hence the last two forms are far more efficient from a software point of view. I suggest a compromise: an 8 digit signed pseudo-number, of the form

± dddmmss

where positive indicates North or West, and negative indicates South or East, ddd are three digits representing degrees, mm are two digits representing minutes, and ss are two digits representing seconds. An accuracy of one second (1") should be sufficient for all GNDB entries, provided that city maps are not supported by the GNDB.

- Positional Accuracy. Unsigned floating point, numeric, range 0 to 32,000 km. Precision to 10 meters (2 decimal digits). This is the error (believed) possible in the position. It depends on the geodetic control of the original map and other factors. It seems unlikely that precisions better than 10 m would be needed for any unclassified geographic name data.
- Date of data capture by AADES. Unsigned 6 digit integer. This entry will go into the audit trail data base, along with the data source. Like position, there are a variety of possible forms:

Alphabetic month, day, year (e.g. Dec. 29, 1983)

Day, alphabetic month, abbreviated year (29 Dec 83)

Day, ordinal month, abbreviated year (29/12/83)

Ordinal month, day, abbreviated year (12/29/83)

The last two forms are preferable from a software viewpoint, but there is the possibility of transposition of day and month if the day is 12 or less. Perhaps the preferable method is to have the date generated by the AADES system, and presented as a six digit pseudonumeric,

ddmmyy

- Type of Romanization: Alphanumeric, 6 characters maximum. As with Data Source Name, aliases should not be used.

- Alphabet Translation Table. Alphanumeric, 6 characters maximum. The entry must be recognized by the DTC&P (ATP) system, in order that the appropriate conversion table be used. Thus a list of valid codes should be developed, and either AADES or GNDB should verify that the entry is valid.
- Feature designator: Alphanumeric, 6 characters maximum. This indicates to what sort of object the geoname applies: population center, waterway, elevation. Aliases will be common here, I would expect.
- Feature attribute: Unsigned 6 digit numeric. This could indicate population for a population center (in thousands of people), size of a waterway, etc. Circle size on the original map should indicate relative population.
- Boundary Crossing: String of numbers. The first number is a two digit integer, indicating the number of positions which follow in the string. It appears that specifying latitude and longitude is the preferable approach here.

APPENDIX V

Equipment Manufacturers

A list of ocr and scanner manufacturers was provided with the Market Briefing, Data Item A001 under this contract. The following is a list of voice input/output equipment manufacturers.

VOICE I/O EQUIPMENT:

1. Centigram Corporation
Phone: 408-734-3222
Sunnyvale, CO
Product of interest: VoiceWare Development System voice input;
compatibility-general instrument SP0250,
SP0256 / TI 5220 / Centigram LISA; Remote
connections supported; OEM; end-user market;
30 installed; 1982; purchase \$35,000
2. Cognitronics Corporation, Speechmaker Division, OCR Division
Phone: 203-327-5307
Stanord, CT
3. Computalker Consultants
Phone: 213-828-6546
Santa Monica, CA
4. Computer Curriculum Corporation
Phone: 415-494-8450
Doloath, CA
5. Datavoice Corporation
Phone: 312-327-8488
Chicago, IL
6. Digital Pathways, Inc.
Phone: 415-493-5544
CA
7. Engineered Systems, Inc.
Phone: 402-333-0100
Omaha, NB
8. IBM (International Business Machines)
Information Systems Group,
National Accounts Division
Phone: 914-696-1900
White Plains, NY
9. Infolink Corporation
Phone: 312-291-2900
IL
10. Interstate Electronics Corp.
(division of A-T-O Inc.)
Phone: 714-772-2811
CA
Product of interest: VRM/VOTERM

Voice input; compatibility-RS-232C,
CCITT V.24/TTL; 100 words input;
Remote connections supported;
OEM; End-user market; 500 installed;
1978; purchase \$2,255

11. Maryland Computer Services, Inc.
Phone: 301-879-3366
MD

12. Mimic, Inc.
Phone: 617-263-2101
MA
Product of interest: MIMIC Speech Processor Voice
input; voice output; compatibility-
OEM/Microcomputer; OEM; end-user market;
1978; purchase \$20-\$300

13. Mountain Computer, Inc.
Phone: 408-438-6650
CA
Product of interest: Supertalker voice input; voice output;
compatibility-IBM/Apple II; OEM; end-user
market; 2000 installed; 1979; purchase
\$199-\$565

14. NEC Information Systems, Inc.
Phone: 617-862-3120
MA
Product of interest: SR-100
Voice input; compatibility-NEC Astra;
120 words input; remote connections
supported; OEM; end-user market; 1982;
purchase \$2000

15. Orion Laboratories, LTD.
Phone: 314-576-5711
MD

16. Perception Technology Corporation
Phone: 617-821-0320
MA

17. Periphonics
(affiliate of Exxon Corporation)
Phone: 516-467-0500

18. Phoenix Computer Graphics, Inc.
Phone: 318-234-0063

19. Scott Instruments Corporation
Phone: 817-387-9514
TX
Products of interest: Shadow/VET Voice Entry
Terminal
Voice input; compatability-Apple; 40

Words input; end-user market; 1984
installed; 1981; purchase \$995

:VET-2 Voice Entry Terminal
voice input; compatibility-Apple; 40
words input; Remote connections supported;
end-user market; 470 installed; 1981; purchase
\$795

20. Telesensory Speech Systems

Phone: 415-964-7023
CA

21. Texas Instruments, Inc.

Phone: 214-995-2011
TX

22. Threshold Technology, Inc.

Phone: 609-461-9200
NJ

Products of interest: Auricle PCB
Auricle 1
Model 500; 580
Model 600; 680
T950 VOice Option Board

All are voice input and support remote connections.
Other characteristics such as number of words input,
compatibility, and price vary.

23. Time and Space Processing, Inc.

Phone: 408-730-0200
CA

Product of interest: 100 Digital Telephone voice
input; voice output; compatibility-
microcomputer; remote connections supported;
OEM; end-user market; 1977

24. Verbex

(division of Exxon Communications Systems)

25. Voice Machine Communications, Inc.

Phone: 714-639-6150
CA

Product of interest: VMC2020
voice input; compatibility-Apple II, IIe;
80-100 words input; remote connections
supported; end-user market; purchase
\$920-995

26. Voicetek

Phone: 805-685-1854
CA

Product of interest: COGNIVOX V10-3003
Voice input; voice output; compatibility-
Apple II; 32 words input and output;
end-user market; 1000 installed; 1980;
purchase \$249

27. Voicetek Corporation

Phone: 617-964-8820

CA

Products of interest: Voice Stor M
Voice Stor, Model 30

Voice input; voice output; compatibility-DG/DEC/OEM Microcomputer;
24,000 words output; remote connections; purchase \$50,000 and \$15,000
respectively

28. Votan

Phone: 415-490-7600

CA

Products of interest: V1000 (Speaker Dependent)
V5000 (Speaker Dependent)
V6000 (Speaker Dependent/Independent)

Voice input; voice output; compatibility-RS-232C-CCITT V.24/
Multibus; 256 words input; 256 words output; remote connections
supported; OEM; end-user market; purchase range \$3200-\$7000.

29. Votrax, Division of Federal Screw Works

Phone: 313-588-2050

Company profiles of the above may be found in Data Sources , Winter 1983
hardware equipment manual.

APPENDIX VI



PAR TECHNOLOGY CORPORATION

MARKET BRIEFING

A MARKET SURVEY OF HARDWARE AND SOFTWARE SUITABLE FOR RASTER
SCANNING AND OPTICAL CHARACTER RECOGNITION FOR USE WITH THE
AUTOMATED ALPHANUMERIC DATA ENTRY SYSTEM (AADES).



PAR TECHNOLOGY CORPORATION

MARKET SURVEY SOURCES

- STANDARD AND POORS
- THOMAS
- DATAPRO FEATURE REPORT
- AUERBACH
- JOURNALS
- PHONE CONTACT



PAR TECHNOLOGY CORPORATION

OUTLINE

- I. OPTICAL CHARACTER READERS
 - CURRENT TECHNOLOGY
 - REPRESENTATIVE SYSTEMS

- II. SCANNING SYSTEMS
 - CURRENT TECHNOLOGY
 - REPRESENTATIVE SYSTEMS

- III. SUMMARY

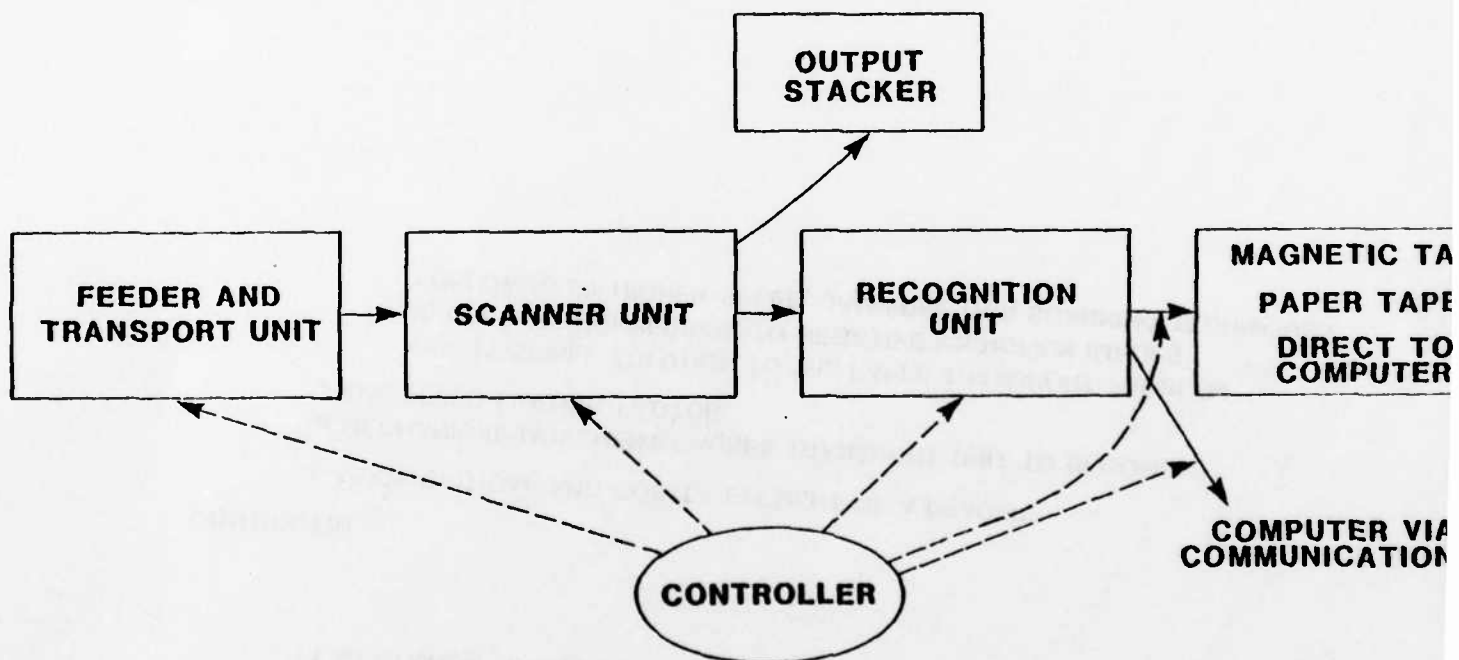


OPTICAL CHARACTER READERS

- o **DOCUMENT READERS** - HANDLE FORMS UP TO 4 x 9 AND READ UP TO 5 LINES/FORM.
- o **PAGE READERS** - HANDLE VARIETY OF FORM SIZES AND READ ABOUT 60 LINES/FORM.
- o **JOURNAL TAPE READERS** - READS ROLLS OF NARROW PAPER TAPE (LISTING TAPES, JOURNAL TAPES, OR TALLY ROLLS).
- o **HAND-HELD WANDS** - READ TAGS, LABELS, OR DOCUMENTS, USUALLY ONE LINE AT A TIME.



FUNCTIONAL DESIGN DIAGRAM OF AN OPTICAL CHARACTER READER





FEEDER AND TRANSPORT UNIT

FUNCTION:

MOVES THE FORMS FROM THE INPUT HOPPER PAST THE SCANNER
READ STATION TO THE OUTPUT STACKER

COMMENTS:

- o MOST CRITICAL AND COSTLY ELEMENT OF A READER.
- o MECHANICAL MOVEMENT CAUSES TRANSPORT UNIT TO BECOME
THE SPEED-LIMITING FACTOR.
- ONE POSSIBLE SOLUTION TO THE PAPER TRANSPORT PROBLEM
IS OFF-LINE CONVERSION TO NEGATIVE MICROFILM IMAGES
FOLLOWED BY HIGHER-SPEED, JAM-FREE OCR SCANNING TECHNIQUES.



SCANNER UNIT

FUNCTION:

TO CONVERT THE PRINTED CHARACTERS TO ELECTRIC SIGNALS FOR ANALYSIS BY THE RECOGNITION UNIT.

COMMENTS:

- o UNITS THAT READ STYLIZED FONTS REDUCE THE RESOLUTION REQUIREMENTS AND THE COST OF THE SCANNER.
- o MOST COMMON TYPES OF SCANNING MECHANISMS ARE:
 - MECHANICAL DISK
 - FLYING SPOT SCANNER
 - LASER SCANNER
 - PARALLEL PHOTOCELLS (RETINA)
 - VIDICON
- o SCANNER TECHNOLOGY CONTINUES TO IMPROVE IN TERMS OF SPEED AND RESOLUTION. SOME RECENT PAGE READERS USED FOR SPECIALIZED APPLICATIONS SUCH AS WORD PROCESSING, UTILIZE THE LASER SCANNING MECHANISM WITH GREAT SUCCESS.



RECOGNITION UNIT

FUNCTION:

ANALYZES THE ELECTRIC SIGNALS AND PERFORMS THE 'RECOGNITION' PROCESS, PREPARING DATA FOR SUBSEQUENT MANIPULATION OR STORAGE.

COMMENTS:

- o DIRECTLY AFFECTS THE MEANS OF DATA PREPARATION AND READER COST.
- o EARLY OCR UNITS IMPLEMENTED RECOGNITION LOGIC IN HARDWARE. RECENT OCR UNITS COMBINE HARDWARE AND SOFTWARE...LOWER SPEEDS, HIGHER COSTS.
- o DIVERSITY OF CHARACTER SETS (NUMERICS vs ALPHANUMERICS) AND WIDE VARIETY OF FONT TYPES.



CONTROLLER

FUNCTION:

TO OVERSEE THE COMPLETE OCR PROCESS FROM DOCUMENT INPUT TO THE VARIED OUTPUT.

COMMENTS:

- o VARIES FROM HARD-WIRED LOGIC CONTROLLING FROM MOVEMENT AND READING TO A MINI/MICROCOMPUTER CONTROLLING DATA ENTRY VERIFICATION, EDITING AND VALIDATION FUNCTIONS.
- o MINI/MICROCOMPUTERS PERMIT ON-LINE CHARACTER REJECT ANALYSIS.



OCR PERFORMANCE

- o THE CONDITION OF THE DOCUMENTS BEING READ IS THE MOST CRITICAL FACTOR AFFECTING OVERALL OCR PERFORMANCE.
- o UNDER RIGIDLY CONTROLLED INPUT DOCUMENT CONDITIONS, CURRENT OCR DEVICES CAN ACHIEVE REJECT RATES AS LOW AS TWO PERCENT AND SUBSTITUTION ERROR RATES OF LESS THAN ONE PERCENT.
- o DOCUMENT CONTROL PLAYS A SIGNIFICANTLY MORE IMPORTANT ROLE IN READING RELIABILITY THAN DOES ANY OTHER SINGLE CONSIDERATION.



OCR VENDORS

AM ECRM
AOM CORPORATION (FORMERLY AMER-O-MATIC)
BALL COMPUTER PRODUCTS, INC.
BELL AND HOWELL
BURROUGHS CORPORATION, IMAGING SYSTEMS
DIVISION
CAERE CORPORATION
CHATSWORTH DATA CORPORATION
COGNITRONICS CORPORATION
COMPUSCAN, INC.
COMPUTER ENTRY SYSTEMS
CONTROL DATA CORPORATION
CUMMINS-ALLISON CORPORATION
DEST DATA CORPORATION
HENDRIX ELECTRONICS
HEWLETT-PACKARD COMPANY
HONEYWELL INFORMATION SYSTEMS

INFORMATION INTERNATIONAL
IBM CORPORATION
INTERMEC, INC.
KEY TRONIC CORPORATION
KIMBALL SYSTEMS, DIVISION OF LITTON
INDUSTRIES
KURZWEIL COMPUTER PRODUCTS, INC.
LUNDY ELECTRONICS AND SYSTEMS, INC.
OPTICAL BUSINESS MACHINES, INC.
PERIPHERAL DYNAMICS, INC.
RECOGNITION EQUIPMENT, INC.
ROCKWELL INTERNATIONAL
SCAN-DATA CORPORATION
SCAN-OPTICS, INC.
SCAN-TRON CORPORATION
UNIVAC DIVISION, SPERRY RAND CORPORATION
WESTINGHOUSE LEARNING CORPORATION



PAR TECHNOLOGY CORPORATION

REPRESENTATIVE OCR

APPLICATION

MEDIA: DOCUMENTS/PAGES
DATA FORM: CHARACTERS
.USE: STAND ALONE, ON- OR OFF-LINE

DOCUMENT HANDLING

SIZE: 3" x 7" TO 9" x 14"

FEED TECHNIQUE: FRICTION

TRANSPORT METHOD: BELT OR DRIVE ROLLERS

INPUT

CHARACTERS PER LINE: 80
LINES PER INCH: 6
LINES PER PASS: FULL PAGE
FIELD SELECTION: NONE, INTERNAL PROGRAM
EDITING & FORMATTING: INTERNAL PROGRAM, OPERATOR
CONTROL, AND COMBINATION

RECOGNITION

FONT OR CODE: VARIETY
CHARACTER SET: ALPHANUMERIC (UPPER/LOWER CASE),
SYMBOLS
FONT SELECTION: HEADER SHEETS, PROGRAM
SCANNING TECHNIQUE: VARIETY
CHARACTER RECOGNITION
TECHNIQUE: VARIETY



PAR TECHNOLOGY CORPORATION

REPRESENTATIVE OCR (CONTINUED)

OUTPUT

MAGNETIC TAPE:	7- OR 9-TRACK
FLOPPY DISK:	--
PUNCHED CARDS:	--
PUNCHED TAPE:	--
COMMUNICATIONS	
LINES:	--
COMPUTER:	VARIETY

PERFORMANCE

DOCUMENTS PER MINUTE:	--
LINES PER INCH:	--
CHARACTERS PER SECOND:	100-3000

ERROR CONTROL

AUTOMATIC RESCAN:	YES
REJECT POCKET:	VARIES
ON -LINE MANUAL CORRECTION:	YES/OPTIONAL

SOFTWARE

RECOGNITION PROCESSING; EDITING AND WORD PROCESSING



PAR TECHNOLOGY CORPORATION

SCAN-DATA CORP
2280/1 OCR SYSTEM

- 0 WELL SUITED TO LARGE-SCALE DATA ENTRY APPLICATIONS SUCH AS INSURANCE, MANUFACTURING, PUBLISHING INDUSTRIES, HEALTH CARE . . .
- 0 TWO REJECT METHODS WHICH ELIMINATE THE NEED TO REKEY ENTIRE DOCUMENT OR FIELD IDENTIFIERS
 - (A) IN-LINE DISPLAY FACILITY
 - (B) SCAN-PLEX I
- 0 COMBINED DOCUMENT AND PAGE READER THAT PROVIDES MAXIMUM FLEXIBILITY IN THE SIZE AND WEIGHT OF ACCEPTABLE INPUT DOCUMENTS
- 0 MAY BE COMBINED WITH THE SCAN-DATA 2250/2 DISTRIBUTED PR SSC TO FORM A MIXED-MEDIA DATA ENTRY SYSTEM



PAR TECHNOLOGY CORPORATION

SCAN-DATA CORP
2280/1 OCR SYSTEM
(CONTINUED)

- 0 FONTS CAN BE INTERMIXED ON A PAGE PROVIDED THEY ARE
CONSISTENT WITHIN ANY SPECIFIC FIELD; INTERMIXED TYPED
OR LINE-PRINTED FONTS ARE PERMITTED IF THERE IS SOME
RECOGNIZABLE FORM OF FIELD IDENTIFIER CHARACTER

- 0 SCANNING PROCESS, REJECT ENTRY, AND FORMATTING ARE
DIRECTED THROUGH 'SCANWARE' - THE SCAN-DATA OCR SOFTWARE
PACKAGE



PAR TECHNOLOGY CORPORATION

SCAN-DATA 2280/1 (CONTINUED)

- SWAMI - SOFTWARE RECOGNITION PACKAGE THAT IS SUBORDINATE TO FORMSCAN; FOR TRAINING ON UNRECOGNIZED CHARACTERS
- FORMAT - PARAMETER-DRIVEN OUTPUT RECORD FORMATTING CONTROL PACKAGE; ALLOWS SIMPLE DEFINITION OF WHERE SCANNED FIELDS ARE TO BE PLACED IN THE OUTPUT RECOGNITION FIELD
- RESCAN - INTERNAL CONTROL MODULE THAT GOVERNS UNRECOGNIZED CHARACTER CORRECTION, SITE VERIFICATION, AND IMAGE-TO-KEY OPERATIONS
- FUNCTIONS - ROUTINES ACCESSED THROUGH USER CODE FOR MOVING, COMPARING, CONVERSIONS, AND ARITHMETIC OPERATIONS
- UTILITIES - PROGRAMMING AND OPERATING AIDS SUCH AS TAPE LIBRARIAN



PAR TECHNOLOGY CORPORATION

SCAN-DATA 2280/1 (CONTINUED)

- DATAPLEX I - SMALL MULTIPROGRAMMED OPERATING SYSTEM THAT
ALLOWS UP TO EIGHT JOBS TO RUN SIMULTANEOUSLY
(E.G. ONE SCAN, UP TO SIX REJECT CORRECTION
STATIONS, AND A TAPE-TO-PRINT OR MEDIA-TO-MEDIA
COPY)
- DATAM - DATA MANAGER THAT PROVIDES MEDIA-INDEPENDENT DATA
FLOW; SCANNING CAN BE TO DISK, FORMAT, TO TAPE
OR TO A LINE PRINTER
- FORMSCAN - PARAMETER-DRIVEN SCANNING CONTROL PACKAGE THAT
ALLOWS SIMPLE DEFINITION OF FORMS, DATA FIELD
LOCATIONS, AND DATA ATTRIBUTES, INCLUDING FONT,
SIZE, AND DATA SET; PROVIDES SEARCHING AND
VARIABLE CONTROL PATHS FOR DATA-DRIVEN FIELD
SCANNING



PAR TECHNOLOGY CORPORATION

DEST CORP
200 SERIES

- 0 FUNCTION AS INPUT DEVICES FOR TEXT PROCESSING SYSTEMS
- 0 DEST, COMPU SCAN, AND AM ECRM SYSTEMS ARE COMPETITIVE LOW-END MODELS IN PRICE AND PERFORMANCE.
 - ALL RECOGNIZE FULL ALPHANUMERIC CHARACTER SETS IN SEVERAL FONTS
 - FONTS NOT AVAILABLE AS STANDARD FEATURES ARE USUALLY AVAILABLE AS OPTIONS
 - ALL PROVIDE A MEANS FOR OPERATOR VIEWING OF QUESTIONABLE CHARACTERS
- 0 SIMULTANEOUS SCANNING AND EDITING; NO EXTENSIVE EDITING CAPABILITIES



PAR TECHNOLOGY CORPORATION

COGNITRONICS CORP
OCR/800 SERIES

- 0 OCR/801 STAND ALONE TURNKEY OCR/OMR DEVICE
 EDUCATIONAL APPLICATIONS; DATA/TEXT PROCESSING
- 0 OCR/802 TURNKEY OCR SYSTEM TO AUTOMATE PROCESSING OF
 OUTGOING COMMERCIAL MESSAGES; TEXT PROCESSING
- 0 UNRECOGNIZED CHARACTERS ACTIVATE AUTOMATIC RESCAN OF LINE;
 PERSISTENT PROBLEM INITIATES VIDEO DISPLAY
- 0 LASER SCANNER SENSITIVE TO ALL COLORS EXCEPT RED AND
 SOME PASTELS
- 0 WILL PROVIDE CUSTOM PROGRAMMING IN THE FIELD IF A USER'S
 APPLICATION REQUIRES MODIFICATION
- 0 COMPARABLE IN PRICE AND PERFORMANCE TO OBM'S LASER OCR
 SERIES; SCAN-OPTICS EASY READER 1750; SCAN DATA'S 2250/1
 AND 2280/2 OCR SYSTEMS



PAR TECHNOLOGY CORPORATION

RECOGNITION EQUIPMENT INC
INPUT 80 SYSTEMS
(CONTINUED)

- 0 OFFERS OPTIONAL KEY-TO-STORAGE DATA ENTRY CAPABILITY (TOTAL DATA ENTRY); UNIQUE IN THAT TWO SEPARATE PROCESSORS ARE USED (ONE FOR RECOGNITION AND ONE FOR THE KEY ENTRY SYSTEM); A TRUE MULTIPROCESSOR SYSTEM
- 0 INTEGRATED RETINA^R AUTOMATICALLY ADJUSTS FOR CHARACTER SIZE VARIATIONS, CHARACTER VERTICAL MISREGISTRATION, AND LINE SKEW OF MACHINE OR HANDPRINT CHARACTERS
- 0 MAINTAINS A SOFTWARE LIBRARY; TAILORS SYSTEM TO APPLICATION
 - REAL-TIME SUPERVISORY PROGRAMS
 - MACHINE LANGUAGE ASSEMBLER
 - UTILITY PROGRAMS
 - DIAGNOSTICS
 - COMMONLY USED SUBROUTINES



PAR TECHNOLOGY CORPORATION

RECOGNITION EQUIPMENT INC
INPUT 80 SYSTEMS

- 0 STAND ALONE, HIGH-SPEED OCR PAGE READERS
- 0 FEATURES A PATENTED INTEGRATED RETINA^R SCANNING SYSTEM, ANALOG RECOGNITION, AND AIR-JET ASSISTED PAPER HANDLING
- 0 HIGH READING SPEEDS, RECOGNITION OF MULTIPLE FONTS ON ONE DOCUMENT, AND HANDLES MULTIPART FORMS, PAGES WITH 'DOG-EARS', IMBEDDED STAPLES, FOLDS, PASTE-ON LABELS . . .
- 0 3 BASIC MODELS, A, B, AND C; EACH MAY BE CONFIGURED AS SINGLE FONT, MULTIFONT (UP TO 9 DIFFERENT TYPE FONTS), AND MULTIFONT (INTERMIXED TYPE FONTS)



PAR TECHNOLOGY CORPORATION

INFORMATION INTERNATIONAL INC
GRAFIX I

- 0 HIGH-SPEED MICROFILM PAGE READER
- 0 VALUABLE FOR WORKING WITH HIGH VOLUME OF DATA TO BE RECORDED WITHOUT RETYPING OR REPRINTING
- 0 CAN READ 'RELATIVELY' UNCONSTRAINED MIXED ALPHANUMERIC UPPERCASE HANDPRINT
- 0 OUTPUT - MAGNETIC TAPE OR DISK DRIVE
- 0 CONFIGURATION:
 - SCANNER
 - OUTPUT DEVICE
 - 4 CRT KEYBOARD CONSOLES
 - FILM TRANSPORT
 - 4 MINICOMPUTERS FOR SYSTEMS CONTROL



PAR TECHNOLOGY CORPORATION

RECOGNITION EQUIPMENT INC
INPUT 80 SYSTEMS
(CONTINUED)

0 COMPETING SYSTEMS ARE THE SCAN-DATA 2250 AND IBM 1287
AND 1288

- INPUT 80 RECOGNITION TECHNIQUE ALLOWS EXTENSIVE
MULTIFONT CAPABILITY
- INPUT 80 KEY ENTRY FEATURE



PAR TECHNOLOGY CORPORATION

KURZWEIL COMPUTER PRODUCTS
KURZWEIL DATA ENTRY MACHINE (KDEM)

- 0 DESIGNED TO READ PROPORTIONALLY AND UNIFORMLY SPACED TYPE-
SET AND TYPEWRITTEN SOURCE DOCUMENTS
- 0 HANDLES ANY FONT OR COMBINATION OF FONTS (EXCEPT SCRIPT)
- 0 FEWER OPTIONAL PERIPHERALS AND POORER SYSTEM 'UPGRADABILITY'
THAN COMPARABLE SYSTEMS (SCAN DATA 2250/2)
- 0 HIGHLY COMPETITIVE
 - SPEED
 - OMNIFONT CHARACTER RECOGNITION CAPABILITY
 - POWERFUL SOFTWARE (EDITING FUNCTIONS)
 - EXTENSIVE COMMUNICATIONS
- 0 CANNOT READ HANDWRITTEN ALPHANUMERICS
- 0 BOTH KDEM AND SCAN DATA 2250/1 FEATURE FONT LEARNING
CAPABILITIES



OCR TRENDS AND FUTURE DEVELOPMENT

- o DEVELOPMENT OF MULTIMEDIA SYSTEMS WITH OCR SCANNERS ARE PROVING HIGHLY SUCCESSFUL; *ie.*, COMPLETE PAYMENT PROCESSING
- o ALPHANUMERIC HANDPRINT READERS WILL CONTINUE TO IMPROVE AND EXPAND AS THEY ARE ACCEPTED IN NEW MARKETS.
- o HAND-HELD WANDS AND OTHER LOW-COST REMOTE SCANNERS WILL BECOME INCREASINGLY IMPORTANT AS THEY ARE UTILIZED IN DISTRIBUTED PROCESSING NETWORKS.
- o LOWER COST DOCUMENT READERS AND HAND-HELD SCANNERS WILL CONTINUE TO FORM THE BULK OF OCR SALES, BUT THE MORE SOPHISTICATED UNITS WILL DROP IN PRICE BECAUSE OF TECHNOLOGICAL ADVANCES AND COMPETITIVE PRESSURES.
- o CONTINUED GROWTH AND DEVELOPMENT OF THE INFORMATIONAL PROCESSING INDUSTRY WHICH ENCOURAGES INTEGRATING RELATED EQUIPMENT INTO TOTAL SYSTEMS DESIGNED FOR SPECIFIC INDUSTRIES.
- o CONTINUED USER AND VENDOR COOPERATION IN DEVELOPING SYSTEMS AND ADAPTING OCR EQUIPMENT TO FIT THESE SYSTEMS; VENDORS AND USERS MUST BE GEARED TOWARD APPLICATIONS DESIGN RATHER THAN MODIFYING APPLICATIONS AND PROCEDURES TO FIT AVAILABLE EQUIPMENT.



PAR TECHNOLOGY CORPORATION

INFORMATION INTERNATIONAL INC
GRAFIX I
(CONTINUED)

- 0 AN OPTIONAL DIGITIZER CAN ALSO BE ATTACHED TO THE BASIC SYSTEM TO INPUT SUCH GEOMETRIC INFORMATION AS PAGE LAYOUT PLANS
- 0 ALTHOUGH CLASSIFIED AS OCR SYSTEM, MUCH MORE POWERFUL AND FLEXIBLE THAN MOST CONTEMPORARY EQUIPMENT; ACTUALLY A DATA INPUT SYSTEM THAT USES FILM IN THE SAME SENSE THAT MAGNETIC TAPE OR DISKS ARE USED AS INPUT MEDIA FOR A COMPUTER
- 0 FREEDOM FROM FONT AND FORMAT RESTRICTIONS BROADENS THE GRAFIX I APPLICATIONS
- 0 THE FIRST GRAFIX I SYSTEM WAS PURCHASED BY THE U.S. NAVY



PAR TECHNOLOGY CORPORATION

KURZWEIL COMPUTER PRODUCTS
KURZWEIL DATA ENTRY MACHINE (KDEM)
(CONTINUED)

- 0 CAN READ DOCUMENTS PRINTED ON LIGHT-COLORED PAPER OF ANY WEIGHT, PRINTED WITH BLACK INK OR CARBON BASED COLORS, TYPEWRITTEN ORIGINALS, OR CLEAR PHOTOCOPIES



PAR TECHNOLOGY CORPORATION

REPRESENTATIVE SCANNING
SYSTEM
('GRAPHIC' SYSTEM)

METHOD	:	FLAT-BED, ROTATING DRUM
SCANNED AREA	:	11" x 14" TO 36" x 36"
SOURCE MEDIA	:	OPAQUE OR TRANSPARENT
COLORS	:	1 TO 12
COLOR CALIBRATION	:	VARIES
RESOLUTION	:	400 LINES/INCH TO 1200 LINES/INCH
APERTURES	:	VARIES; MOST HAVE A RANGE
SOFTWARE	:	RASTER TO VECTOR CONVERSION; EDITING AND GRAPHICS FUNCTIONS; DATA BASE MANAGEMENT

no.



PAR TECHNOLOGY CORPORATION

SCANNING SYSTEMS VENDORS

BENSON

BROOMALL INDUSTRIES INC.

EIKONIX

KONGSBERG

LASER - SCAN LIMITED

OPTRONICS INTERNATIONAL

SCITEX CORPORATION LTD.

Anatech

Intergraph

np.



PAR TECHNOLOGY CORPORATION

SCANNING SYSTEMS VENDORS

BENSON

BROOMALL INDUSTRIES INC.

EIKONIX

KONGSBERG

LASER - SCAN LIMITED

OPTRONICS INTERNATIONAL

SCITEX CORPORATION LTD.

Anatech

Intergraph



PAR TECHNOLOGY CORPORATION

LASER-SCAN LIMITED
FASTRAK

- 0 CONSISTS OF THREE UNITS:
 - OPTICS UNITS
 - OPERATOR CONSOLE
 - SYSTEM COMPUTER (DIGITAL PDP-11)

- 0 FILM BASED SYSTEM (PHOTOGRAPHIC REDUCTION OF ORIGINAL SOURCE DOCUMENT); STANDARD A6 MICROFICHE (148MM X 105MM) BUT MATERIAL TO BE DIGITIZED MUST BE WITHIN A 96MM X 68MM FRAME

- 0 FEATURE ACCEPTANCE AND CODING CAPABILITIES

- 0 EDIT AND MERGE FUNCTIONS FOR DOCUMENTS EXCEEDING THE DIGITIZED AREA, FOR ADDING MATERIAL FROM ANOTHER SOURCE, OR FOR COMPLETING AN INTERRUPTED JOB



PAR TECHNOLOGY CORPORATION

SCITEX CORPORATION LTD.
RESPONSE-200 SERIES

- 0 COMPUTER AIDED DESIGN EMPHASIS
- 0 ACCEPTS SOURCE MAPS IN ANY FORM DRAWN OR PRINTED ON A FLEXIBLE MEDIUM (UP TO 36" X 36"), TRANSPARENT OR OPAQUE; MANUSCRIPTS, SEPARATES, PRINTED MAPS . . .
- 0 LARGER MAPS CAN BE INPUT IN SECTIONS AND MERGED BACK ELECTRONICALLY DURING EDITING.
- 0 AUTOMATIC COLOR CALIBRATION - CAN BE TRAINED TO RECOGNIZE UP TO 12 COLORS/MAP
- 0 SOPHISTICATED GRAPHIC EDITING
- 0 TEST ENTERED FROM KEYBOARD; NO CHARACTER RECOGNITION



PAR TECHNOLOGY CORPORATION

BROOMALL INDUSTRIES INC.
SCAN-GRAPHICS
(CONTINUED)

0 SOFTWARE

- RAVE - RASTER TO VECTOR CONVERSION
- IGMS - INTERACTIVE DISPLAY/EDITING
SOFTWARE AND UTILITY FUNCTIONS
- OUT PLOT - CONTROLS OUTPUT PLOTTING



PAR TECHNOLOGY CORPORATION

BROOMALL INDUSTRIES INC.
SCAN-GRAPHICS

0 AUTOMATIC SYSTEMS FOR DIGITIZING GRAPHIC DOCUMENTS,
CONVERTING FROM RASTER DATA BASE TO VECTOR DATA
BASE, INTERACTIVELY EDIT, DISPLAY, MANIPULATE, AND
STORE SCANNED DATA

0 SYSTEMS RANGE FROM AUTOMATIC DIGITIZING MODULES TO ADD
TO EXISTING SYSTEMS TO COMPLETE TURNKEY SYSTEMS

- SCANNERS
- DIGITIZERS
- COMPUTERS
- AGDS (AUTOMATIC GRAPHICS DIGITIZING SYSTEMS)
STATIONS
- PERIPHERALS SUCH AS PRINTERS, PLOTTERS,
MICROFILM RECORDERS . . .



PAR TECHNOLOGY CORPORATION

SUMMARY
AND
CONCLUSIONS

OPTICAL CHARACTER READERS:
'CHARACTER' LOCATION AND ORIENTATION
RESTRICTIONS.
DOCUMENT SIZE RESTRICTION.

SCANNING SYSTEMS:
EMPHASIZE COLOR SEPARATION AND
MANUAL EDITING VERSATILITY.
EMPHASIZE 'GRAPHIC' APPLICATIONS
AND SOFTWARE. DO NOT DEAL WITH
TEXT OR 'DATA NAMES' CAPTURE.

APPENDIX VII

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